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Contribution to the knowledge on the distribution of Recent free-living freshwater ostracods (Podocopida, Ostracoda, Crustacea) in Slovenia

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Izvleček. An updated checklist of recent free-living freshwater ostracods (Podocopida, Ostracoda, Crustacea) from Slovenia together with new records is presented. The new checklist is based on both the records extracted from the literature and the sampling in the field carried out during the last decade. The present checklist comprises 61 species. However, the eastern part of Slovenia and the surface waters are underrepresented. It is expected that the number of species will increase in the future.

Key words: Ostracoda, species, fauna, freshwaters, groundwaters

Abstract. PRISPEVEK K POZNAVANJU RAZŠIRJENOSTI RECENTNIH PROSTOŽIVEČIH DVOKLOPNIKOV (PODOCOPIDA, OSTRACODA, CRUSTACEA) V CELINSKIH VODAH SLOVENIJE – Avtorja predstavljata najnovejši seznam recentnih vrst prostoživečih dvoklopnikov (Podocopida, Ostracoda, Crustacea) iz celinskih voda Slovenije ter nove najdbe za Slovenijo. Novi seznam temelji na podatkih, povzetih iz obstoječih publikacij, ter podatkih, pridobljenih med terenskim vzorčenjem v zadnjih 10 letih, ter vsebuje 61 vrst. Pričakovati je, da je število vrst veliko večje, saj primanjkuje podatkov iz vzhodne Slovenije in iz površinskih vod, ki so manj intenzivno vzorčevane kot podzemne vode.

Ključne besede: Ostracoda, vrste, favna, celinske vode, podzemne vode

Introduction

Despite the fact that Slovenia is being recognized as a biodiversity hotspot, a preliminary list of Recent free-living freshwater ostracods (Podocopida, Ostracoda, Crustacea) from Slovenia reports only 47 species (Griffiths & Brancelj 1996a). For comparison, in Western Europe, without the Mediterranean and Dinaric regions, 158 species (Meisch 2000) and, at the global scale, 2090 species belonging to about 209 genera are known at present (Martens & Savatenalinton 2011).

The first known record of ostracods for Slovenia is from the cave Podpeška jama at Dobrepolje near Velike Lašče, where stygobiotic species »similar to *Cyclocypris ovum* but flatter« was mentioned (Joseph 1882). The next report is from Postojna, where two species were collected from the larger dripping pool in the cave Črna jama (Schmeil 1893). The species were named *Typhlocypris schmeili* and *Cypris pellucida* by G.W. Müller, but later never described. In 1920, Paris reported on *Typhlocypris eremita* (Veydovský, 1880), again from the cave Podpeška jama (Paris 1920). In the 1930's, Walter Klie described four new species from the caves Podpeška jama (*Candona aemonae* Klie, 1935; *Cypria stygia* Klie, 1935), Postojnska jama (*Candona trigonella* Klie, 1931) and Krška jama (*Candona cavicola* Klie, 1935) and an additional one from the Krka River near Novo mesto (*Leptocythere fluviatilis* Klie, 1939) (Klie 1931, 1935, 1939). Moreover, W. Klie received from S. Karaman the material from the cave Luknja near Novo mesto and identified it as *Notodromas persicae* Gurney (Klie 1938). At the same time, H.J. Stammer referred in his work on the fauna from the Timavo River to several species collected in Submediterranean Slovenia (Stammer 1932). More recently, T. Petkovski published scattered information on the occurrence of ostracods in Slovenia within his reports on Yugoslav fauna (Petkovski 1958, 1959, 1960a, b, 1964, 1969). Two new species were described by D. Danielopol in 1978 (*Pseudocandona pretneri* Danielopol, 1978) and T. Petkovski & C. Meisch in 1994 (*Cypria bicolor* Petkovski & Meisch, 1994). The first species was collected from the spring Rak near Cerknica (Danielopol 1982) and the second one from the spring Ižica near Ljubljana (Petkovski & Meisch 1994). At the end of the last century, H. Griffiths carried out a sampling campaign of mostly Alpine lakes and co-authored the preliminary checklist for Slovenia (Griffiths & Brancelj 1996a) as well as a paper about the palaeo-biogeography of *Candona bimucronata* in the Balkans, including Slovenia (Griffiths & Brancelj 1996b).

In 2002, an extensive field sampling was carried out in the karst and alluvial aquifers south of Ljubljana with the aim to assess the groundwater biodiversity of the area and compare it to other European regions (EU PASCALIS project, Dole-Olivier et al. 2009, Mori et al. 2011a). On that occasion, the present authors started to collaborate on the taxonomy and distribution of the freshwater ostracods in Slovenia. After that, ostracods were continuously collected and identified during several field samplings carried out by the National Institute of Biology (Mori & Brancelj 2011, Mori et al. 2011b, 2012).

The present paper summarizes the history of ostracod research in Slovenia and presents an overview of all the species recorded in this country until the present. Additionally, it provides a list of unpublished new records for Slovenia, with information on their geographical location and habitat type. The species list includes the species that were previously reported in the literature and records that were obtained through field sampling by the first author during

the last 10 years. It provides general information on geographical distribution, the habitats where species were collected and lists all the publications in which the species were reported. This work provides an updated information on the occurrence of this neglected crustacean group in Slovenia and demonstrates, as it was shown by many other specialists, that Slovenia is a biodiversity hotspot (Sket 1999) also as far as ostracods are concerned.

Material in methods

Only recent free-living freshwater ostracods were considered in this work. First, a careful examination of the existing original literature reporting on the occurrence of ostracods in Slovenia during the last two centuries was carried out. Based on this literature, a new species list was composed in order to update the nomenclature and to avoid possible errors from the preliminary check list published by Griffiths & Brancelj (1996a). Next, the data obtained from the first author's field samplings, starting in 2002, are included. Hence, the present species list contains all the species reported in the literature published since 1920 (Brancelj et al. 1995, Danielopol 1982, Dole-Olivier et al. 2009, Griffiths & Brancelj 1996a, b, Klie 1931, 1935, 1938, 1939, Mori & Brancelj 2011, Mori et al. 2011a, b, 2012, Paris 1920, Petkovski 1959, 1960a, b, 1964, 1969, Petkovski & Meisch 1994, Sket & Velkovrh 1981), as well as so far unpublished species records of the first author from 2002 to the present. The species are listed according to the classification proposed by Martens & Savatenalinton (2011). Only the most important synonyms are listed, more of them are available in Martens & Savatenalinton (2011). The species with *nomen nudum* are discarded from the list to avoid confusion (Joseph 1882, Schmeil 1893).

The list of locations for the species collected by the first author from 2002 onwards is provided. That list contains the geographical name of the corresponding location, the habitat type, Gauss–Krüger coordinates, altitude, date of collecting and the name of the persons who collected the sample and identified the species. The localities selected during the EU PASCALIS project were sampled by several different field workers from NIB and Biotechnical Faculty in Ljubljana and their names are not specified.

In the species list, a valid species name, the general information on geographical distribution based on the phytogeographic division of Slovenia (AL – Alpine, SA – Subalpine, SM – Submediterranean, DN – Dinaric, SD – Subdinaric, SP – Subpannonian) (Wraber 1969) and habitats types where the species was collected are provided. Additionally, for each species, the publications where the species was reported until present are cited. For each genus, the type species is marked by asterisk (*).

List of species

Class Ostracoda Latreille, 1806
Subclass Podocopa G.W. Müller, 1894
Order Podocopida G.O. Sars, 1866

Superfamily Cypridoidea Baird, 1845

Family Cyprididae Baird, 1845
Subfamily Cypricercinae McKenzie, 1971
**Bradleycypris obliqua* (Brady, 1868) [*Cypris obliqua* (Brady, 1868)]
AL, DN - lake littoral - Griffiths & Brancelj 1996a

Subfamily Cypridopsinae Kaufmann, 1900
Cavernocypris subterranea (Wolf, 1920) [*Cypridopsis subterranea* Wolf, 1920]
AL, DN, SM - spring benthos and drift, lake littoral, caves - Brancelj et al. 1995, Griffiths & Brancelj 1996a, Mori et al. 2011b
**Cypridopsis vidua* (O.F. Müller, 1776) [*Cypris vidua* (O.F. Müller, 1776)]
AL, DN, SD, SM - lake littoral, swamp, river benthos, hyporheic zone, caves - Klie 1931, Stammer 1932, Griffiths & Brancelj 1996a
Potamocypris fallax Fox, 1967
AL - river and spring benthos - Griffiths & Brancelj 1996a
**Potamocypris fulva* (Brady, 1868) [*Bairdia fulva* Brady, 1868]
AL, DN - spring benthos and drift, hyporheic zone - Mori et al. 2011b
Potamocypris pallida Alm, 1914
AL - spring benthos - Mori et al. 2011b
Potamocypris similis G.W. Müller, 1912
AL - spring benthos, swamp - Griffiths & Brancelj 1996a
Potamocypris smaragdina (Vâvra, 1891) [*Cypridopsis smaragdina* Vâvra, 1891]
AL – swamp - Griffiths & Brancelj 1996a
Potamocypris variegata (Brady & Norman, 1889) [*Cypridopsis variegata* Brady & Norman, 1889]
SD - river benthos
Potamocypris villosa (Jurine, 1820) [*Monoculus villosa* Jurine, 1820]
SM - cave, spring - Stammer 1932, Griffiths & Brancelj 1996a
Potamocypris zschokkei (Kaufmann, 1900) [*Paracypridopsis zschokkei* Kaufmann, 1900]
AL, DN - spring benthos and hyporheic zone of the headwaters - Brancelj et al. 1995, Griffiths & Brancelj 1996a, b, Dole-Olivier et al. 2009, Mori et al. 2011b

Subfamily Cyprinotinae Bronshtein, 1947
**Heterocypris incongruens* (Ramdohr, 1808) [*Cypris incongruens* Ramdohr, 1808]
AL - ponds, lake littoral - Griffiths & Brancelj 1996a
Heterocypris reptans (Kaufmann, 1900) [*Microcypris reptans* Kaufmann, 1900]
DN, SM - spring benthos - Stammer 1932, Petkovski 1964

Subfamily Dolerocypridinae Triebel, 1961

Dolerocypris sinensis G.O. Sars 1903
SA/SD - pit overgrown by dense vegetation - Petkovski 1960a

Subfamily Eucypridinae Bronshtein, 1947

Eucypris pigra (Fischer, 1851) [*Cypris pigra* Fischer, 1851]
AL, DN - benthos and hyporheic zone - Mori et al. 2011b
**Eucypris virens* (Jurine, 1820) [*Monoculus virens* Jurine, 1820]
DN - lake littoral - Griffiths & Brancelj 1996a

Subfamily Herpetocypridinae Kaufmann, 1900

Psychrodromus fontinalis (Wolf, 1920) [*Ilyodromus fontinalis* Wolf, 1920]
AL - spring benthos, river benthos - Griffiths & Brancelj 1996a, Mori et al. 2011b
**Psychrodromus olivaceus* (Brady & Norman, 1889) [*Erpetocypris olivacea* Brady & Norman, 1889]
AL - river benthos - Griffiths & Brancelj 1996a

Subfamily Scottiinae Bronshtein, 1947

**Scottia pseudobrowniana* Kempf, 1971
DN - spring benthos - Dole-Olivier et al. 2009

Family Candonidae Kaufmann, 1900
Subfamily Candoninae Kaufmann, 1900
Tribe Candonini Kaufmann, 1900

Candona bimucronata Klie, 1937
AL - lake littoral - Griffiths & Brancelj 1996a, b
**Candona candida* (O.F. Müller, 1776) [*Cypris candida* O.F. Müller, 1776]
AL, SA, DN, SD, SM - lake littoral, river benthos and hyporheic zone, spring benthos, caves - Stammer 1932, Sket & Velkovrh 1981, Brancelj et al. 1995, Griffiths & Brancelj 1996a, b, Mori & Brancelj 2011, Mori et al. 2012
Candona lindneri G.O. Petkovski, 1969
DN, SM - spring and river benthos - Petkovski 1969, Griffiths & Brancelj 1996a
Candona neglecta Sars, 1887
AL, SD. Habitat: lake littoral, spring benthos, hyporheic zone, moss - Brancelj et al. 1995, Griffiths & Brancelj 1996a
**Cryptocandona vavrai* Kaufman, 1900
AL, SA, DN - spring benthos, hyporheic zone - Mori et al. 2011b
Fabaeformiscandona aemonae (Klie, 1935) [*Candona aemonae* Klie, 1935]
AL, SA, DN, SD – spring benthos, hyporheic zone, caves - Klie 1935, Dole-Olivier et al. 2009, Mori et al. 2011a, 2012
Fabaeformiscandona breuili (Paris, 1920) [*Candona breuili* Paris, 1920]
AL, SA, DN - spring benthos, hyporheic zone - Mori & Brancelj 2011, Mori et al. 2011b
Fabaeformiscandona brevicornis (Klie, 1925) [*Candona brevicornis* Klie, 1925]
DN - spring benthos, hyporheic zone
Fabaeformiscandona brisiaca (Klie, 1938) [*Candona brisiaca* Klie, 1938]
AL - spring drift - Mori et al. 2011b
Fabaeformiscandona latens (Klie, 1940) [*Candona latens* Klie, 1940]
AL- spring benthos - Mori et al. 2011b.

Mixtacandona chappuisi (Klie, 1943) [*Candona chappuisi* Klie, 1943]
DN - spring benthos, hyporheic zone - Dole-Olivier et al. 2009
Mixtacandona lattingerae Rogulj & Danielopol 1993
DN - spring benthos - Dole-Olivier et al. 2009
**Mixtacandona laisi* (Klie, 1938) [*Candona laisi* Klie, 1938] Syn.: *Candona stammeri* Klie, 1938
DN - spring benthos, hyporheic zone - Dole-Olivier et al. 2009, Mori et al. 2011b
**Nannocandona faba* Eckman, 1914
AL - lake littoral - Brancelj et al. 1995, Griffiths & Brancelj 1996a.
Pseudocandona albicans (Brady, 1864) [*Candona albicans* Brady, 1864]
AL, SA, DN, SD, SM - caves, spring benthos, hyporheic zone - Griffiths & Brancelj 1996a
Pseudocandona lobipes (Hartwig, 1900) [*Candona lobipes* Hartwig, 1900]
SD - *Sphagnum* moss
Pseudocandona pratensis (Hartwig, 1901) [*Candona pratensis* Hartwig, 1901]
DN - lake littoral
Typhlocypris cavicola (Klie, 1935) [*Candona cavicola* Klie, 1935]
DN - caves, spring benthos, hyporheic zone - Klie 1935, Dole-Olivier et al. 2009
Typhlocypris eremita (Veydovský, 1880) [*Cypris eremita* Veydovský, 1880]
DN - cave - Paris 1920, Dole-Olivier et al. 2009
Typhlocypris pretneri Danielopol, 1978
DN - spring drift - Danielopol 1978, Danielopol 1982, Dole-Olivier et al. 2009
Typhlocypris trigonella (Klie, 1931) [*Candona trigonella* Klie, 1931]
DN - pond in a cave - Klie 1931

Tribe Candonopsini Karanovic, 2004
Candonopsis scourfieldi Brady, 1910
SA, DN - spring benthos and hyporheic zone

Subfamily Cyclocypridinae Kaufmann, 1900
**Cyclocypris globosa* (Sars, 1863) [*Cypris globosa* Sars, 1863]
SD - *Sphagnum* moss
Cyclocypris laevis (O.F. Müller, 1776) [*Cypris laevis* O.F. Müller, 1776]
AL, DN - lake littoral and spring benthos - Griffiths & Brancelj 1996a
Cyclocypris ovum (Jurine, 1820) [*Monoculus ovum* Jurine, 1820]
AL, SA - lake littoral, river benthos, Brancelj et al. 1995, Griffiths & Brancelj 1996a, b
Cypria bicolor Petkovski & Meisch, 1994
DN - spring benthos - Petkovski & Meisch 1994
Cypria cavernae Wagenleitner, 1990
DN - spring benthos - Dole-Olivier et al. 2009.
**Cypria exsculpta* Fischer, 1855 [*Cypris exsculpta* Fischer, 1855]
AL - lake littoral - Griffiths & Brancelj 1996a
Cypria lacustris Lilljeborg, 1890
SA, DN, SA - well, spring benthos, hyporheic zone - Petkovski 1960b
Cypria ophtalmica (Jurine, 1820) *[Monoculus ophtalmica* Jurine, 1820]
AL, SA, DN, SD, SM - lake littoral, spring benthos, hyporheic zone, caves - Klie 1931, 1939, Stammer 1932, Klie 1939, Brancelj et al. 1995, Griffiths & Brancelj 1996a, b

Cypria reptans Brohnstein, 1928
AL, DN - caves, spring benthos, hyporheic zone - Klie 1935, Petkovski & Meisch 1994, Griffiths & Brancelj 1996a
Cypria sketi Petkovski, 1976
DN - spring benthos, hyporheic zone, pond

Family Ilyocyprididae Kaufmann, 1900
Subfamily Ilyocypridinae Kaufmann, 1900
Ilyocypris bradyi G.O.Sars 1890
SA, DN, SD - Petkovski 1958, Griffiths & Brancelj 1996a.
**Ilyocypris gibba* (Ramdohr, 1808) [*Cypris gibba* Ramdohr, 1808]
AL, SA - Petkovski 1958, Griffiths & Brancelj 1996a
Ilyocypris inermis Kaufmann, 1900
SM - spring benthos - Griffiths & Brancelj 1996a

Family Notodromadidae Kaufmann, 1900
Subfamily Notodromadinae Kaufmann, 1900
**Notodromas monacha* (O.F. Müller, 1776) [*Cypris monacha* O.F. Müller, 1776]
AL – pond - Petkovski 1959
Notodromas persica Gurney, 1921
DN – cave - Klie 1938

Superfamily Darwinuloidea Brady & Roberston, 1885
Family Darwinulidae Brady & Robertson, 1885
**Darwinula stevensoni* (Brady & Robertson, 1870) [*Polycheles stevensoni* Brady & Norman, 1889]
AL - lake littoral - Griffiths & Brancelj 1996a

Superfamily Cytheroidea Baird, 1850

Family Cytherideidae Baird, 1850
Subfamily Cytherideinae Sars, 1925
**Cytherissa lacustris* (Sars, 1863) [*Cythere lacustris* Sars, 1863]
AL - lake littoral - Griffiths & Brancelj 1996a, b

Family Leptocytheridae Sars, 1925
Leptocythere fluviatilis Klie, 1939
DN - river benthos - Klie 1939

Family Limnocytheridae Klie, 1938
Subfamily Limnocytherini Klie, 1938
**Limnocythere inopinata* (Baird, 1843) [*Cythere inopinata* Baird, 1843]
AL; swamp, lake littoral - Griffiths & Brancelj 1996a.
Limnocytherina sanctipatricii (Brady & Robertson, 1869) [*Limnocythere sanctipatricii* Brady & Robertson, 1869]
AL - lake littoral - Griffiths & Brancelj 1996a, b

New records for Slovenia

1. Jama Ob Savi, Brestanica, cave, 5093457 5531401, 169 m a. s. l., 17.1.05, leg. A. Kapla, det. N. Mori: *Typhlocypris cavicola*
2. Škocjanske jame, Divača, cave, 5058470 5421620, 320 m a. s. l., 1.2.05, leg. A. Kapla, det. C. Meisch: *Typhlocypris cavicola*
3. Škocjanske jame, Divača, cave, 5058470 5421620, 320 m a. s. l., 17.2.05, leg. A. Kapla, det. N. Mori: *Cavernocypris subterranea*
4. Turjeva jama, Kobarid, cave, 5123233 5385050, 253 m a. s. l., 20.3.05, leg. A. Kapla, det. N. Mori: *Fabaeformiscandona aemonae*
5. Velika Pasica, Ig, cave, 5086180 5461052, 700 m a. s. l., 26.9.07, leg. A. Brancelj, det. N. Mori: *Pseudocandona albicans*
6. Slabetova jama, Vrhnika, cave, 5094862 5440268, 436 m a. s. l., 1.9.02, Pascalis 2002, det. C. Meisch: *Fabaeformiscandona aemonae*
7. Lipnik spring, Bled, benthos, 5138308 5425554, 650 m a. s. l., 10.6.09, leg. B. Oz, det. N. Mori: *Cavernocypris subterranea*
8. Lipnik spring, Bled, benthos, 5138308 5425554, 650 m a. s. l., 4.11.09, leg. B. Oz, det. N. Mori: *Fabaeformiscandona breuili*
9. Lipnik spring, Bled, benthos, 5138308 5425554, 650 m a. s. l., 26.4.12, leg. M. Opalički, det. N. Mori: *Psychrodromus fontinalis*
10. spring at Breg pri Borovnici, Borovnica, benthos, 5088350 5451050, 300 m a. s. l., 19.8.02, Pascalis 2002, det. C. Meisch: *Cypria sketi, Mixtacandona laisi, Pseudocandona albicans, Typhlocypris cavicola*
11. spring at Šivčev grič, Borovnica, benthos, 5091450 5452950, 290 m a. s. l., 21.8.02, Pascalis 2002, det. C. Meisch: *Cypria sketi*
12. spring at Podkamnik, Borovnica, benthos, 5091250 5454700, 295 m a. s. l., 21.8.02, Pascalis 2002, det. C. Meisch: *Cypria reptans, Heterocypris reptans, Pseudocandona albicans, Typhlocypris cavicola*
13. spring at Preserje, Borovnica, benthos, 5091625 5454825, 295 m a. s. l., 21.8.02, Pascalis 2002, det. C. Meisch: *Typhlocypris cavicola*
14. spring at Ribič, Borovnica, benthos, 5088525 5448900, 300 m a. s. l., 29.8.02, Pascalis 2002, det. C. Meisch: *Cypria reptans, Fabaeformiscandona aemonae*
15. spring at Dol pri Borovnici, Borovnica, benthos, 5087500 5449875, 300 m a. s. l., 29.8.02, Pascalis 2002, det. C. Meisch: *Cypria reptans, Ilyocypris bradyi, Pseudocandona albicans, Typhlocypris cavicola*
16. spring at Ohonica, Borovnica, benthos, 5084325 5451775, 340 m a. s. l., 29.8.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi*
17. spring at Malence, Borovnica, benthos, 5085450 5450375, 450 m a. s. l., 6.9.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi, Scottia pseudobrowniana*
18. spring Veliko Bojišče, Borovnica, benthos, 5084775 5450825, 500 m a. s. l., 6.9.02, Pascalis 2002, det. C. Meisch: *Fabaeformiscandona brevicornis, Fabaeformiscandona breuili*

19. spring pod Sv. Jožefom, Borovnica, benthos, 5090850 5454650, 295 m a. s. l., 16.9.02, Pascalis 2002, det. C. Meisch: *Cypria reptans*
20. spring at Ponikve, Borovnica, spring, 5495550 5455450, 300 m a. s. l., 10.12.2002, Pascalis 2002, det. C. Meisch: *Typhlocypris cavicola*
21. spring Kotliči, Cerknica, benthos, 5072085 5445511, 600 m a. s. l., 1.7.11, leg. N. Mori, det. N. Mori: *Typhlocypris cavicola*
22. spring Rak, Cerknica, benthos, 5072479 5446769, 640 m a. s. l., 28.7.11, leg. N. Mori, det. N. Mori: *Typhlocypris cavicola*
23. Dobličko jezero, Črnomelj, benthos, 5045288 5511640, 200 m a. s. l., 12.7.05, leg. A. Kapla, det. N. Mori: *Cypria sketi*
24. spring Mrzlica, Ig, benthos, 5085650 5460000, 760 m a. s. l., 26.8.02, Pascalis 2002, det. C. Meisch: *Potamocypris fulva*
25. spring under Mišnice, Ig, benthos, 5084775 5459675, 800 m a. s. l., 26.8.02, Pascalis 2002, det. C. Meisch: *Potamocypris fulva*
26. spring Gabrovica, Ig, benthos, 5084500 5462775, 680 m a. s. l., 29.8.02, Pascalis 2002, det. C. Meisch: *Cypria reptans, Potamocypris fulva*
27. spring Korito, Ig, benthos, 5078800 5462275, 690 m a. s. l., 3.9.02, Pascalis 2002, det. C. Meisch: *Candona neglecta, Cypria reptans*
28. spring at Ižanka, Ig, benthos, 5092100 5463650, 290 m a. s. l., 8.9.02, Pascalis 2002, det. C. Meisch: *Cyclocypris laevis, Cypria reptans*
29. spring in Draga, Ig, benthos, 5087750 5465500, 320 m a. s. l., 19.9.02, Pascalis 2002, det. C. Meisch: *Cypria reptans, Mixtacandona laisi*
30. spring at Krška jama cave, Ivančna Gorica, benthos, 5082866 5482680, 272 m a. s. l., 28.7.11, leg. N. Mori, det. N. Mori: *Typhlocypris cavicola*
31. spring in the Vrata valley, Jesenice, benthos, 5144888 5416086, 720 m a. s. l., 9.7.09, leg. B. Oz, det. N. Mori: *Cavernocypris subterranea, Potamocypris fulva, Psychrodromus fontinalis*
32. Završnica spring, Jesenice, benthos, 5141732 5438568, 943 m a. s. l., 16.6.09, leg. B. Oz, det. N. Mori: *Cavernocypris subterranea*
33. Završnica spring, Jesenice, drift, 5141732 5438568, 943 m a. s. l., 20.10.10, leg. N. Mori, det. N. Mori: *Psychrodromus fontinalis*
34. Javorniški potok spring, Jesenice, benthos, 5146689 5432032, 1108 m a. s. l., 16.6.09, leg. B. Oz, det. N. Mori: *Psychrodromus fontinalis*
35. Javorniški potok spring, Jesenice, benthos, 5146689 5432032, 1108 m a. s. l., 4.11.09, leg. B. Oz, det. N. Mori: *Cavernocypris subterranea*
36. Kamniška Bistrica spring, Kamnik, benthos, drift, 5131603 5468851, 600 m a. s. l., 4.6.09, leg. B. Oz, det. N. Mori: *Cavernocypris subterranea, Mixtacandona laisi*
37. Črna spring, Luče, benthos, 5140596 5472340, 740 m a. s. l., 1.7.09, leg. B. Oz, det. N. Mori: *Cavernocypris subterranea*
38. Pavličevo sedlo spring, Luče, drift, 5141860 5469638, 1232 m a. s. l., 1.7.09, leg. N. Mori, det. N. Mori: *Fabaeformiscandona brisiaca, Psychrodromus fontinalis, Fabaeformiscandona latens, Cavernocypris subterranea, Cryptocandona vavrai*, *Potamocypris zschokkei*

39. Presušnik spring, Mojstrana, benthos, 5148330 5422931, 1220 m a. s. l., 16.6.09, leg. B. Oz, det. N. Mori: *Eucypris pigra*
40. Presušnik spring, Mojstrana, benthos, 5148330 5422931, 1220 m a. s. l., 8.9.09, leg. B. Oz, det. N. Mori: *Candona neglecta*
41. Presušnik spring, Mojstrana, drift, 5148330 5422931, 1220 m a. s. l., 2.9.10, leg. N. Mori, det. N. Mori: *Fabaeformiscandona breuili, Potamocypris fulva*
42. Rogovilc spring, Mozirje, drift, 5139436 5477797, 669 m a. s. l., 2.7.09, leg. N. Mori, det. N. Mori: *Psychrodromus fontinalis, Potamocypris zschokkei*
43. Rogovilc, Mozirje, drift, 5139436 5477797, 669 m a. s. l., 18.6.10, leg. N. Mori, det. N. Mori: *Fabaeformiscandona breuili, Cavernocypris subterranea, Potamocypris fallax*
44. spring at Resnik, Podkraj, benthos, 5092750 5459750, 290 m a. s. l., 19.9.02, Pascalis 2002, det. C. Meisch: *Cyclocypris laevis, Cypria reptans*
45. spring at Koprivec, Podlipa, benthos, 5095925 5448250, 300 m a. s. l., 25.10.02, Pascalis 2002, det. C. Meisch: *Fabaeformiscandona aemonae , Ilyocypris bradyi*
46. spring at Podpeč, Podpeč, benthos, 5092100 5455200, 295 m a. s. l., 21.8.02, Pascalis 2002, det. C. Meisch: *Cypria sketi, Ilyocypris bradyi, Mixtacandona lattingerae, Mixtacandona laisi, Typhlocypris cavicola*
47. spring at Podkraj, Podpeč, benthos, 5092134 5459145, 300 m a. s. l., 30.8.02, Pascalis 2002, det. C. Meisch: *Cypria reptans, Typhlocypris cavicola*
48. spring at Podkraj, Podpeč, benthos, drift, 5092134 5459145, 300 m a. s. l., 2.3.12, leg. B. Mežnarič, det. N. Mori: *Cypria reptans, Mixtacandona chappuisi, Typhlocypris cavicola*
49. spring at Podpeško jezero, Podpeč, benthos, 5091300 5456825, 290 m a. s. l., 30.8.02, Pascalis 2002, det. C. Meisch: *Typhlocypris cavicola, Cypria reptans, Typhlocypris cavicola*
50. spring at pond, Podpeč, benthos, 5091315 5456811, 300 m a. s. l., 6.7.12, leg. B. Mežnarič, det. N. Mori: *Cypria reptans, Heterocypris reptans*
51. spring at Jezero, Podpeč, benthos, 5092050 5456125, 300 m a. s. l., 19.9.02, Pascalis 2002, det. C. Meisch: *Cyclocypris laevis, Cypria reptans , Fabaeformiscandona aemonae, Typhlocypris cavicola*
52. spring at Virje, Podpeč, benthos, 5092384 5457464, 300 m a. s. l., 25.10.02, Pascalis 2002, det. C. Meisch: *Typhlocypris cavicola*
53. spring at Virje, Podpeč, drift, 300 m a. s. l., 6.7.12, leg. B. Mežnarič, det. N. Mori: *Typhlocypris cavicola*
54. spring Vogli, Strahomer, benthos, 5088338 5460613, 310 m a. s. l., 30.7.02, Pascalis 2002, det. C. Meisch: *Cypria reptans, Mixtacandona chappuisi*
55. spring at Strahomer pond, Strahomer, benthos, 5087950 5460725, 320 m a. s. l., 25.9.02, Pascalis 2002, det. C. Meisch: *Typhlocypris cavicola*
56. spring Močilo, Škrilje, benthos, 5084800 5465875, 590 m a. s. l., 29.8.02, Pascalis 2002, det. C. Meisch: *Fabaeformiscandona breuili*
57. springs at Mošenik, Tržič, drift, 5141621 5444173, 807 m a. s. l., 16.6.09, leg. N. Mori, det. N. Mori: *Cavernocypris subterranea*

58. springs at Mošenik , Tržič, benthos, 5141621 5444173, 807 m a. s. l.,
16.6.09, leg. B. Oz, det. N. Mori*: Potamocypris pallida, Potamocypris zschokkei, Psychrodromus fontinalis*
59. spring at Ogrin, Velika Ligojna, benthos, 5094500 5445725, 295 m a. s. l.,
30.8.02, Pascalis 2002, det. C. Meisch: *Candonopsis scourfieldi, Pseudocandona albicans*
60. spring Moravc, Velika Ligojna, benthos, 5095000 5444725, 320 m a. s. l.,
30.8.02, Pascalis 2002, det. C. Meisch: *Fabaeformiscandona aemonae*
61. Malo okence, Vrhnika, benthos, 5089750 5445775, 300 m a. s. l.,
30.8.02, Pascalis 2002, det. C. Meisch: *Cypria cavernae, Cypria lacustris, Typhlocypris cavicola, Typhlocypris eremita*
62. Veliki Močilnik, Vrhnika, benthos, 5090225 5445500, 300 m a. s. l.,
30.8.02, Pascalis 2002, det. C. Meisch: *Mixtacandona laisi, Typhlocypris cavicola*
63. Korita on Planja, Vrhnika, benthos, 5092300 5442850, 500 m a. s. l.,
9.9.02, Pascalis 2002, det. C. Meisch: *Cypria reptans*
64. spring in Kobilja dolina, Vrhnika, benthos, 5096150 5447875, 320 m a. s. l.,
16.9.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi*
65. spring at Velika Ligojna, Vrhnika, benthos, 5095150 5446300, 355 m a. s. l.,
16.9.02, Pascalis 2002, det. C. Meisch: *Fabaeformiscandona breuili, Fabaeformiscandona brevicornis, Mixtacandona chappuisi*
66. spring at Mala Ligojna, Vrhnika, benthos, 5095550 5441825, 350 m a. s. l.,
25.7.02, Pascalis 2002, det. C. Meisch: *Cryptocandona vavrai*
67. spring at Želimlje, Želimlje, benthos, 5086200 5467375, 320 m a. s. l.,
30.7.02, Pascalis 2002, det. C. Meisch: *Candonopsis scourfieldi*
68. spring at Podreber, Želimlje, benthos, 5086550 5467650, 310 m a. s. l.,
30.7.02, Pascalis 2002, det. C. Meisch: *Cyclocypris laevis, Mixtacandona chappuisi, Typhlocypris cavicola*
69. spring at Turjak castle, Želimlje, benthos, 5081650 5469475, 355 m a. s. l.,
19.9.02, Pascalis 2002, det. C. Meisch: *Cypria reptans*
70. Dremavščica spring, Želimlje, drift, 5089275 5466900, 295 m a. s. l.,
30.11.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi, Typhlocypris cavicola*
71. Sava, Ljubljana, HZ, 5104638 5468541, 278 m a. s. l.,
27.12.04, leg. G. Bračko, det. N. Mori: *Candona candida*
72. Sava, Ljubljana, HZ, 5104402 5465197, 278 m a. s. l.,
27.12.04, leg. G. Bračko, det. N. Mori: *Typhlocypris cavicola*
73. Sava, Ljubljana, HZ, 5108049 5459811, 296 m a. s. l.,
13.7.07, leg. N. Mori, det. N. Mori: *Candona candida*
74. Sava, Ljubljana, HZ, 5108049 5459811, 296 m a. s. l.,
13.7.07, leg. N. Mori, det. N. Mori: *Fabaeformiscandona aemonae*
75. Sava, Ljubljana, HZ, 5108079 5459762, 291 m a. s. l.,
20.8.08, leg. U. Žibrat, det. N. Mori: *Pseudocandona albicans*
76. Sava, Naklo, HZ, 5125566 5445065, 366 m a. s. l.,
20.8.08, leg. U. Žibrat, det. N. Mori: *Pseudocandona albicans*

77. Sava, Radovljica, HZ, 5132549 5436600, 406 m a. s. l.,
20.8.08, leg. U. Žibrat, det. N. Mori: *Fabaeformiscandona breuili*
78. Sava, Jevnica, HZ, 5104727 5479620, 251 m a. s. l.,
21.8.08, leg. U. Žibrat, det. N. Mori: *Cypria reptans*
79. Želimeljščica, Želimlje, HZ, 5080873 5469709, 370 m a. s. l.,
8.5.02, Pascalis 2002, det. C. Meisch: *Fabaeformiscandona breuili*
80. Želimeljščica, Želimlje, HZ, 5082311 5469014, 345 m a. s. l.,
8.5.02, Pascalis 2002, det. C. Meisch: *Cypria reptans , Potamocypris fulva , Pseudocandona albicans , Fabaeformiscandona breuili*
81. Želimeljščica, Želimlje, HZ, 5083125 5468825, 336 m a. s. l.,
14.5.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi, Pseudocandona albicans*
82. Želimeljščica, Želimlje, HZ, 5083125 5468875, 336 m a. s. l.,
14.5.02, Pascalis 2002, det. C. Meisch: *Cypria reptans*
83. Želimeljščica, Želimlje, HZ, 5084000 5468350, 332 m a. s. l.,
16.5.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi*
84. Želimeljščica, Želimlje, HZ, 5084300 5468200, 331 m a. s. l.,
16.5.02, Pascalis 2002, det. C. Meisch: *Fabaeformiscandona breuili, Mixtacandona chappuisi, Pseudocandona albicans , Typhlocypris cavicola*
85. Želimeljščica, Želimlje, HZ, 5085050 5467950, 320 m a. s. l.,
16.5.02, Pascalis 2002, det. C. Meisch: *Cypria reptans , Mixtacandona chappuisi, Pseudocandona albicans*
86. Želimeljščica, Želimlje, HZ, 5086450 5467650, 309 m a. s. l.,
16.5.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi, Fabaeformiscandona breuili, Pseudocandona albicans, Typhlocypris cavicola*
87. Želimeljščica, Želimlje, HZ, 5087450 5466850, 301 m a. s. l.,
17.5.02, Pascalis 2002, det. C. Meisch: *Fabaeformiscandona breuili, Fabaeformiscandona brevicornis, Pseudocandona albicans, Mixtacandona chappuisi*
88. Želimeljščica, Želimlje, HZ, 5088450 5466500, 297 m a. s. l.,
30.5.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi, Pseudocandona albicans*
89. Želimeljščica, Želimlje, HZ, 5088998 5466383, 295 m a. s. l.,
25.7.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi, Pseudocandona albicans*
90. Iška, Iška vas, HZ, 5084300 5461000, 375 m a. s. l.,
31.5.02, Pascalis 2002, det. C. Meisch: *Fabaeformiscandona aemonae , Fabaeformiscandona breuili, Potamocypris zschokkei*
91. Iška, Iška vas, HZ, 5084750 5461050, 363 m a. s. l.,
31.5.02, Pascalis 2002, det. C. Meisch: *Pseudocandona albicans*
92. Iška, Iška vas, HZ, 5085250 5461425, 359 m a. s. l.,
31.5.02, Pascalis 2002, det. C. Meisch: *Pseudocandona albicans*
93. Iška, Iška vas, HZ, 5086690 5462300, 342 m a. s. l.,
12.6.02, Pascalis 2002, det. C. Meisch: *Pseudocandona albicans , Cypria sketi , Candona candida, Fabaeformiscandona breuili, Fabaeformiscandona brevicornis*

94. Iška, Iška vas, HZ, 5088113 5462847, 327 m a. s. l.,
12.6.02, Pascalis 2002, det. C. Meisch: *Pseudocandona albicans*
95. Iška, Iška vas, HZ, 5088501 5462130, 320 m a. s. l.,
13.6.02, Pascalis 2002, det. C. Meisch: *Typhlocypris cavicola*
96. Iška, Iška vas, HZ, 5088641 5461752, 314 m a. s. l.,
13.6.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi, Typhlocypris cavicola*
97. Iška, Iška vas, HZ, 5088586 5460885, 310 m a. s. l.,
13.6.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi, Typhlocypris cavicola*
98. Iška, Iška vas, HZ, 5088586 5460885, 310 m a. s. l.,
13.6.02, Pascalis 2002, det. C. Meisch: *Eucypris pigra, Mixtacandona chappuisi, Pseudocandona albicans, Typhlocypris cavicola*
99. Iška, Iška vas, HZ, 5090419 5460469, 302 m a. s. l.,
18.6.02, Pascalis 2002, det. C. Meisch: *Typhlocypris cavicola, Pseudocandona albicans*
100. Iška, Iška vas, HZ, 5091822 5460057, 295 m a. s. l.,
18.6.02, Pascalis 2002, det. C. Meisch: *Typhlocypris cavicola*
101. Iška, Iška vas, HZ, 5091822 5460057, 295 m a. s. l.,
18.6.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi, Typhlocypris cavicola*
102. Borovniščica, Borovnica, HZ, 5083142 5451708, 340 m a. s. l.,
19.6.02, Pascalis 2002, det. C. Meisch: *Fabaeformiscandona aemonae , Fabaeformiscandona breuili, Typhlocypris cavicola, Mixtacandona chappuisi, Cypria reptans, Mixtacandona laisi*
103. Borovniščica, Borovnica, HZ, 5083751 5452208, 320 m a. s. l.,
19.6.02, Pascalis 2002, det. C. Meisch: *Cryptocandona vavrai , Mixtacandona laisi , Typhlocypris cavicola, Cypria reptans, Cypridopsis vidua, Fabaeformiscandona aemonae*
104. Borovniščica, Borovnica, HZ, 5084334 5452301, 310 m a. s. l.,
19.6.02, Pascalis 2002, det. C. Meisch: *Mixtacandona laisi*
105. Borovniščica, Borovnica, HZ, 5082674 5453088, 340 m a. s. l.,
20.6.02, Pascalis 2002, det. C. Meisch: *Typhlocypris cavicola*
106. Borovniščica, Borovnica, HZ, 5084779 5452057, 309 m a. s. l.,
20.6.02, Pascalis 2002, det. C. Meisch: *Mixtacandona laisi*
107. Borovniščica, Borovnica, HZ, 5083360 5452956, 325 m a. s. l.,
21.6.02, Pascalis 2002, det. C. Meisch: *Mixtacandona laisi*
108. Borovniščica, Borovnica, HZ, 5084381 5452723, 320 m a. s. l.,
21.6.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi*
109. Borovniščica, Borovnica, HZ, 5084775 5452375, 310 m a. s. l.,
8.7.02, Pascalis 2002, det. C. Meisch: *Candona candida, Typhlocypris cavicola, Mixtacandona chappuisi, Cypria reptans, Mixtacandona laisi*
110. Borovniščica, Borovnica, HZ, 5085100 5451750, 305 m a. s. l.,
8.7.02, Pascalis 2002, det. C. Meisch: *Fabaeformiscandona aemonae, Mixtacandona chappuisi, Mixtacandona laisi , Typhlocypris cavicola, Fabaeformiscandona brevicornis*
111. Borovniščica, Borovnica, HZ, 5085150 5451925, 305 m a. s. l.,
8.7.02, Pascalis 2002, det. C. Meisch: *Pseudocandona albicans, Typhlocypris cavicola, Mixtacandona chappuisi, Cypria reptans, Mixtacandona laisi*

112. Borovniščica, Borovnica, HZ, 5086450 5451300, 300 m a. s. l.,
8.7.02, Pascalis 2002, det. C. Meisch: *Mixtacandona laisi, Typhlocypris cavicola, Cypria reptans, Typhlocypris cavicola*
113. Borovniščica, Borovnica, HZ, 5087950 5450750, 290 m a. s. l.,
8.7.02, Pascalis 2002, det. C. Meisch: *Candona candida, Cypria reptans, Mixtacandona chappuisi, Pseudocandona albicans*
114. Podlipščica, Podlipa, HZ, 5095875 5440000, 350 m a. s. l.,
9.7.02, Pascalis 2002, det. C. Meisch: *Cypria lacustris, Potamocypris zschokkei*
115. Podlipščica, Podlipa, HZ, 5093753 5442972, 322 m a. s. l.,
16.7.02, Pascalis 2002, det. C. Meisch: *Mixtacandona chappuisi, Cypria reptans*
116. Podlipščica, Podlipa, HZ, 5094242 5443255, 300 m a. s. l.,
17.7.02, Pascalis 2002, det. C. Meisch: *Candona candida, Cypria reptans*
117. Podlipščica, Podlipa, HZ, 5094169 5444172, 297 m a. s. l.,
17.7.02, Pascalis 2002, det. C. Meisch: *Fabaeformiscandona breuili, Pseudocandona albicans*
118. Podlipščica, Podlipa, HZ, 5094106 5445296, 293 m a. s. l.,
18.7.02, Pascalis 2002, det. C. Meisch: *Pseudocandona albicans*
119. Podlipščica, Podlipa, HZ, 5093785 5445750, 291 m a. s. l.,
18.7.02, Pascalis 2002, det. C. Meisch: *Cryptocandona vavrai , Pseudocandona albicans*
120. Podlipščica, Podlipa, HZ, 5095243 5440925, 329 m a. s. l.,
25.7.02, Pascalis 2002, det. C. Meisch: *Candonopsis scourfieldi, Cryptocandona vavrai , Fabaeformiscandona breuili, Typhlocypris cavicola*
121. Bača, Tolmin, HZ, 5113650 5406900, 190 m a. s. l.,
11.6.04, leg. N. Mori, det. C. Meisch: *Pseudocandona albicans*
122. Bača, Tolmin, HZ, 5113650 5406900, 190 m a. s. l.,
20.11.04, leg. N. Mori, det. C. Meisch: *Candona candida*
123. Bača, Tolmin, HZ, 5112200 5405325, 180 m a. s. l.,
11.6.04, leg. N. Mori, det. C. Meisch: *Pseudocandona albicans, Candona candida*
124. Bača, Tolmin, HZ, 5111916 5405126, 180 m a. s. l.,
20.11.04, leg. N. Mori, det. C. Meisch: *Fabaeformiscandona breuili*
125. Bača, Tolmin, HZ, 5111916 5405126, 180 m a. s. l.,
12.11.04, leg. N. Mori, det. C. Meisch: *Cypria ophtalmica*
126. Bača, Tolmin, drift, 5112200 5405325, 180 m a. s. l.,
26.10.04, leg. N. Mori, det. C. Meisch: *Cyclocypris ovum, Fabaeformiscandona breuili*
127. Vipava, Miren, HZ, 5083614 5391029, 40 m a. s. l.,
22.9.08, leg. U. Žibrat, det. N. Mori: *Typhlocypris cavicola*
128. Kolpa, Otok, benthos, 5052872 5524142, 140 m a. s. l.,
3.8.05, leg. N. Mori, det. N. Mori: *Cypridopsis vidua, Potamocypris variegata*
129. Rožnik, Ljubljana, moss, 5102125 5459400, 350 m a. s. l.,
15.4.05, leg. S. Lukančič, det. C. Meisch: *Cyclocypris globosa, Candona neglecta , Pseudocandona lobipes*
130. Cerknica Lake, Cerknica, lake littoral, 5065129 5452515, 575 m a. s. l.,
1.5.05, leg. S. Lukančič, det. N. Mori: *Pseudocandona pratensis*

131. Bohinj Lake, Bohinjska Bistrica, lake littoral, 5126808 5410814, 527 m a. s. l., 21.6.05, leg. A. Brancelj, det. N. Mori: *Bradleycypris obliqua, Candona neglecta, Cyclocypris ovum , Cypridopsis vidua, Limnocytherina sanctipatricii*
132. Bohinj Lake, Bohinjska Bistrica, lake littoral, 5127243 5414214, 527 m a. s. l., 22.6.05, leg. A. Brancelj, det. N. Mori: *Candona candida , Cyclocypris ovum, Cypria ophtalmica , Pseudocandoma rostrata*
133. Bohinj Lake, Bohinjska Bistrica, lake littoral, 5126884 5414222, 527 m a. s. l., 22.6.05, leg. A. Brancelj, det. N. Mori: *Candona neglecta, Cyclocypris ovum, Cypria exsculpa, Cypria ophtalmica, Cypridopsis vidua, Limnocytherina sanctipatricii*

* HZ – hyporheic zone (depth between 30 and 60 cm in the river bed and between 60 and 90 cm in the later gravel bars)

Discussion

The intensive field sampling and taxonomical work carried out during the last ten years resulted in several new Ostracoda records for Slovenia. At present, 61 species belonging to 25 genera and 6 families are listed for Slovenia. Moreover, several new species to science need to be described. Altogether, only 23 papers have been published from 1882 until present that report on original findings of Ostracoda in Slovenian freshwaters. Since the focus of the first author's research work are groundwaters in the southern (Dinaric region) and northwestern Slovenia (Alpine region), the surface species and species that are distributed in the eastern Slovenia (Subpannonian region) are still underrepresented.

The present checklist comprises species with a wide distribution across the whole of Europe as well as a number of groundwater species which are most probably endemic in Slovenia and/or the Dinaric region. In the Slovenian Red list of endangered crustaceans, five ostracod species were reported as single site endemics (*C. reptans*, *F. aemonae*, *T. cavicola*, *T. trigonella* and *T. pretneri*) (Sket & Brancelj 1992). After the intensive sampling of groundwater habitats (karst and alluvial aquifers) of Slovenia, it is clear that the first three species are widespread across southern and western Slovenia. The taxonomical position of the last two species is currently under revision, from which it appears that at least *T. pretneri* is a synonym with *T. cavicola* (Meisch & Mori, in preparation). Further, as proposed by Griffiths & Brancelj (1996a), the intensification of field sampling resulted in records of several species from the genera *Fabaeformiscandona* and *Mixtacandona* that had earlier not been included in a preliminary list even with a single species. It is expected that future data collection from the surface waters and from the eastern part of the country will further increase the number of recorded species and that a number of species currently considered as »single site« species will be more widespread.

Povzetek

Poznavanje dvoklopnikov v Sloveniji je bilo doslej razmeroma skromno. V prispevku je predstavljen najnovejši seznam recentnih vrst prostoživečih dvoklopnikov (Podocopida, Ostracoda, Crustacea) iz celinskih voda, ki vključuje podatke, povzete iz obstoječih publikacij, ter še neobjavljene najdbe za Slovenijo, pridobljene med terenskim vzorčenjem v zadnjih 10 letih. Novi seznam vsebuje 61 vrst iz 25 rodov in 6 družin. Intenzivno sistematično vzorčenje med evropskim projektom PASCALIS je pokazalo, da so nekatere vrste, predhodno znane kot lokalno endemične, splošno razširjene v slovenskem Dinarskem krasu. Pričakuje se, da je dejansko število vrst veliko večje, saj primanjkuje podatkov iz vzhodne Slovenije, ter iz površinskih voda, ki so manj intenzivno vzorčevane kot podzemne vode.

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Contribution to the knowledge of the Odonata fauna of Bosnia and Herzegovina – Results of the ECOO 2012

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Abstract. As a part of the 2nd European Congress on Odonatology (ECOO 2012), which was held in the beginning of July 2012 in Belgrade (Serbia), a post congress excursion to Bosnia and Herzegovina was organized. Between 6 and 12 August 2012, altogether 36 localities in three biogeographical regions throughout Bosnia and Herzegovina were surveyed, and 52 dragonfly species were found. This represents 83% of the hitherto recorded dragonfly species for the country. The most significant results are the second record and a new locality of *Somatochlora metallica*, second record of *Coenagrion hastulatum,* and first observation of the strong population of *Lindenia tetraphylla* for the country. New records of rare and/or threatened species, i.e. *Coenagrion ornatum*, *Ceriagrion tenellum*, *Caliaeschna microstigma, Cordulegaster heros* and *Selysiothemis nigra*, are also reported. The records of the most interesting species are briefly discussed from the aspects of biogeography and nature conservation.

Key words: Odonata, dragonflies, distribution, Bosnia and Herzegovina, the Balkans

Izvleček. PRISPEVEK K POZNAVANJU ODONATNE FAVNE BOSNE IN HERCEGOVINE – REZULTATI ECOO 2012 – Kot del drugega evropskega odonatološkega kongresa (ECOO 2012), ki je v začetku julija 2012 potekal v Beogradu (Srbija), je bila organizirana pokongresna ekskurzija v Bosno in Hercegovino. V času med 6. in 12. julijem 2012 je bilo v treh biogeografskih regijah pregledanih 36 lokalitet in popisanih 52 vrst kačjih pastirjev, kar je 83 % vseh znanih vrst kačjih pastirjev za Bosno in Hercegovino. Med pomembnejšimi je bilo zabeleženo drugo pojavljanje in novo nahajališče kovinskega lesketnika (*Somatochlora metallica*), drugo pojavljanje barjanskega škratca (*Coenagrion hastulatum*) in prvo opažanje populacije velike peščenke (*Lindenia tetraphylla*) za državo. Poročamo tudi o novih nahajališčih redkih in/ali ogroženih vrst: koščičnega škratca (*Coenagrion ornatum*), rdečega voščenca (*Ceriagrion tenellum*), bledega vetrnjaka (*Caliaeschna microstigma*), velikega studenčarja (*Cordulegaster heros*) in temnega slaniščarja (*Selysiothemis nigra*). Najzanimivejše najdbe so na kratko opisane z biogeografskega in naravovarstvenega vidika.

Ključne besede: Odonata, kačji pastirji, razširjenost, Bosna in Hercegovina, Balkan

Introduction

Bosnia and Herzegovina is a small country located in the western part of the Balkan Peninsula (Fig. 1). Karst mountains cover the largest, central part of the country separating the southern and the Mediterranean area of Herzegovina from the lowland area of North Bosnia. As a consequence, three biogeographical regions can be distinguished: the Mediterranean, Alpine and Continental (Kulijer et al. 2013, Redžić et al. 2008).

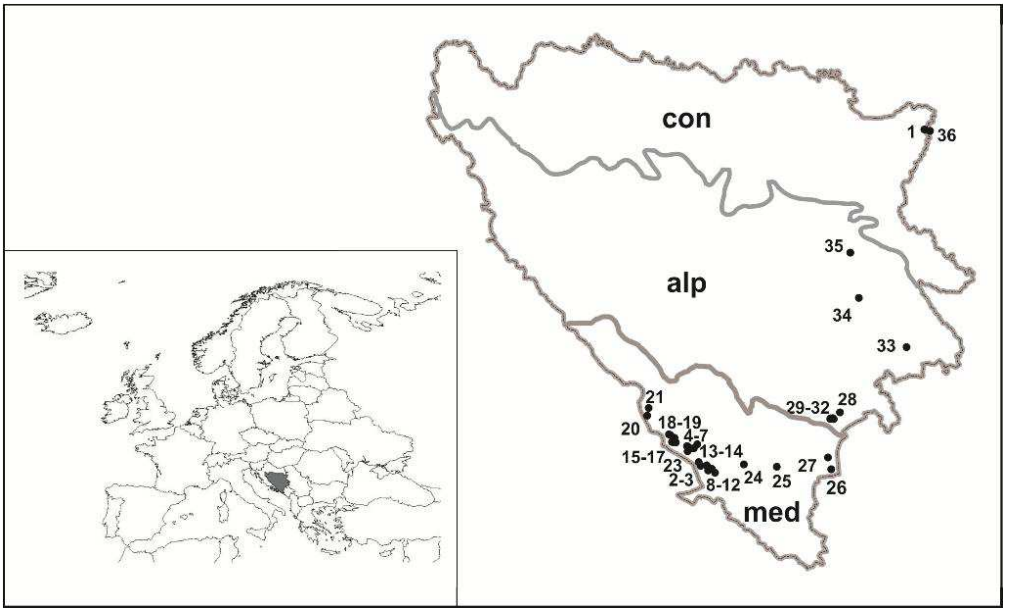

Figure 1. Geographical position of Bosnia and Herzegovina with the borders of biogeographical regions (med – Mediterranean, alp – alpine, con - continental) and the position of localities investigated during the post congress excursion of the 2nd European Congress on Odonatology (ECOO 2012).
Slika 1. Geografski položaj Bosne in Hercegovine s prikazom mej biogeografskih regij (med – sredozemska, alp – alpska, con - celinska) in lego lokalitet, preučevanih v okviru pokongresne ekskurzije 2. evropskega odonatološkega kongresa (ECOO 2012).

Due to the poor research activities in the past, and as a consequence of the recent war, the country remained one of the least explored in Europe in terms of dragonfly fauna. Although numerous papers with dragonfly records from the country have been published over the past 120 years, most of them include only small number of records or cover only a small portion of the investigated area. The earliest dragonfly records from the country originate from 1888, and can be found in the entomological collection of the National Museum of Bosnia and Herzegovina, where some of the first specimens from the Balkan Peninsula are kept (Kulijer & Marinov 2010). This collection is the most significant source of information on dragonflies of Bosnia and Herzegovina from the past. More than 60 years ago, the old Odonata collection of the National Museum of Bosnia and Herzegovina was reviewed by Adamović (1948), who reported 45 species for the country. In a brief overview of the dragonfly fauna of the former Yugoslav republics, Bedjanič & Bogdanović (2006) mention a

total of 53 species for Bosnia and Herzegovina, while Boudot et al. (2009) listed 50 species for the country. Recently, Jović et al. (2010) compiled a list of 57 dragonfly species, based upon reviewing the literature and new faunistic data. Several papers, which contribute to the knowledge of the dragonfly fauna in the country, have also been published recently, including Bedjanič (2011) and Kulijer (2012).

The dragonfly studies in Bosnia and Herzegovina have recently been significantly intensified, and a great number of new records have become available. In 2009, a national survey and mapping of dragonfly distribution in the country was launched, and the dragonfly database of Bosnia and Herzegovina was created (Kulijer et al. 2013). The first comprehensive revision of Odonata in Bosnia and Herzegovina that includes all available data from literature, revision of museum collections, and a significant number of new, previously unpublished records is given by Kulijer et al. (2013). It includes records of 63 species for the country.

As the 2nd European Congress on Odonatology (ECOO 2012) was held in Belgrade (Serbia) in the beginning of July 2012, it was an opportunity to investigate the dragonfly fauna of the Balkan Peninsula as well as to present richness of species and habitats of one of the most preserved and odonatologically least known regions of Europe. Two post congress excursions to Bosnia and Herzegovina and Macedonia were organized. In this article, we present and discuss results of the post congress excursion to Bosnia and Herzegovina made between 6 and 12 August 2012.

Study area

Our survey included all three biogeographical regions of the country. Northern Bosnia, bordering on the Sava River in the north, is a lowland region under the continental influence from Central Europe and Pannonian planes that stretch further to the north. In this area we visited two localities: one on the first (L 1) and one on the last day of the survey (L 36). At both locations, numerous gravel pits were found; some of them were largely overgrown by vegetation and hardly accessible, while others that are still in use were more or less without vegetation. At the last location we also inspected a small section of the Drina River in the border area to Serbia.

South Herzegovina region, influenced by the Mediterranean climate from the Adriatic Sea, with 55 known species, is the dragonfly richest region of the country (Kulijer et al. 2013). The most interesting habitats in this area are found in the lower part of the Neretva River basin. Our research focused on Hutovo Blato Nature Park and the Trebižat River Valley. Hutovo Blato (L 8-12) is one of the most important marshland areas of the country, and one of the most significant dragonfly areas. While traveling from the Neretva River Valley towards the mountain areas of East Bosnia, we also inspected several habitats at the Bregava River (L 24), Dabarsko polje (L 25) and Gatačko polje (L 26-27).

Some of the most interesting habitats in central part of the country are glacial lakes, ponds and bogs in the high mountain zone above 1,400 m. These lakes host populations of several species, mainly of the northern European distribution which, in this area, are at the southern border of their distributions (Kulijer et al. 2013). On one of the last survey days we inspected some of these habitats in Zelengora Mts. in Sutjeska National Park, where most of these lakes are located. In Zelengora Mts., we inspected the Donje Bare and Gornje Bare Lakes, and forest habitats along the road and ponds near Gornje Bare Lake (L 28-32). While traveling through Central Bosnia, we also made few quick stops in order to investigate several habitats, mainly running water (L 33-35).

Material and methods

The Odonata were surveyed between 6 and 12 August 2012. The weather during the survey period was sunny, sometimes with high noon temperatures of over 35 ^{o}C, or 40 ^{o}C in the Mediterranean area. In general, the weather was very favourable for dragonflies, and mostly without rain or wind.

Mainly dragonfly adults were observed, while exuviae and larvae were searched for only sporadically. In total, we visited 36 localities (Fig. 1, Tab. 1): 26 in the Mediterranean region, 8 in the Alpine region, and 2 in the Continental region of the country. The division into three biogeographical regions is based on the map of the distribution of biogeographical regions in Europe (EEA 2005).

Our intention was to investigate as many different habitats as possible, but the short time of the excursion limited the research. The selection of localities was based on the possibility to find the most interesting species, and to present the diversity of species and habitats of the West Balkans and – with it – Bosnia and Herzegovina. Although we visited all three biographical regions of the country, the restricted time enabled detailed study only in the Mediterranean region. This region hosts some of the most interesting and most endangered taxa in the country. The region is characterized by rich and diverse freshwater habitats that are insufficiently researched.

All the records collected during this research have been entered into the national dragonfly database, and voucher specimens deposited in the collections of the National Museum of Bosnia and Herzegovina in Sarajevo.

Table 1. List of the localities investigated during the post congress excursion of the 2nd European Congress on Odonatology (ECOO 2012) to Bosnia and Herzegovina. For each locality geographical coordinates, altitudes and the survey dates are given.

Tabela 1. Seznam preučevanih lokalitet v okviru pokongresne ekskurzije 2. evropskega odonatološkega kongresa (ECOO 2012) v Bosno in Hercegovino. Za vsako lokaliteto je dodan zapis geografskega položaja, nadmorske višine in datum preučevanja.

	Locality name	X	Y	Alt. [m]	Date
1.	Gravel pits at Pavlović Bridge, Bijeljina	44^0 47' 21''	19^0 17' 54''	88	6-VII-2012
2.	Neretva River near Struge	43^0 04' 54''	17^0 41' 55''	2	7-VII-2012
3.	Trebižat River near Gorica	43^0 06' 03''	17^0 41' 08''	14	7-VII-2012
4.	Spring near Donji Studenci	43^0 10' 10''	17^0 37' 41''	49	7-VII-2012
5.	Vakuf spring at Studenci	43^0 10' 47''	17^0 36' 26''	41	7-VII-2012
6.	Spring and small stream at Gornji Studenci	43^0 10' 51''	17^0 36' 10''	60	7-VII-2012
7.	Road near Studenci	43^0 10' 49''	17^0 36' 24''	66	7-VII-2012
8.	Škrka Lake, Hutovo blato	43^0 05' 02''	17^0 44' 31''	4	8-VII-2012
9.	Canal and Krupa River at Karaotok (by boat), Hutovo blato	43^0 03' 59''	17^0 46' 35''	2	8-VII-2012
10.	Deransko Lake (by boat), Hutovo blato	43^0 02' 48''	17^0 47' 59''	2	8-VII-2012
11.	Krupa River from Karaotok to Svitavsko Lake, Hutovo blato	43^0 03' 27''	17^0 45' 03''	3	8-VII-2012
12.	Small canal and ponds near Karaotok, Hutovo blato	43^0 04' 15''	17^0 45' 06''	4	8-VII-2012
13.	Međugorje, village centre	43^0 11' 27''	17^0 40' 33''	160	9-VII-2012
14.	Road south of Međugorje	43^0 10' 14''	17^0 39' 06''	142	9-VII-2012
15.	Small canal at Humac village, Ljubuški	43^0 11' 58''	17^0 31' 28''	74	9-VII-2012
16.	Vrioštica River at Kutac, Ljubuški	43^0 12' 06''	17^0 30' 27''	72	9-VII-2012
17.	Mlade River at Lošče, Ljubuški	43^0 12' 09''	17^0 29' 53''	72	9-VII-2012
18.	Spring at Proboj, Ljubuški	43^0 13' 26''	17^0 30' 53''	99	9-VII-2012
19.	Spring of Vrioštica River, Vitina	43^0 14' 15''	17^0 29' 10''	94	9-VII-2012
20.	Spring and River Tihaljina at Peč Mlini	43^0 20' 10''	17^0 19' 26''	266	9-VII-2012
21.	Krenica Lake, Drinovci	43^0 22' 29''	17^0 19' 57''	257	9-VII-2012
22.	Road at Utvica, Vitina	43^0 14' 28''	17^0 28' 36''	86	9-VII-2012
23.	Kravice Waterfall and Trebižat River	43^0 09' 21''	17^0 36' 30''	48	10-VII-2012
24.	Bregava River NE of Stolac	43^0 05' 20''	18^0 00' 01''	109	10-VII-2012
25.	Small spring, stream and canal at Pribitu, Dabarsko karst polje	43^0 04' 38''	18^0 13' 49''	482	10-VII-2012
26.	Small pond at Kazanci, Gatačko karst polje	43^0 03' 45''	18^0 36' 38''	951	10-VII-2012
27.	Pond near Gareva village, Gatačko karst polje	43^0 07' 23''	18^0 35' 21''	919	10-VII-2012
28.	Road to Bare, Zelengora mountain	43^0 21' 10''	18^0 40' 29''	917	11-VII-2012
29.	Wet meadow and small ponds near Gornje Bare Lake	43^0 19' 21''	18^0 36' 29''	1521	11-VII-2012
30.	Gornje Bare Lake	43^0 19' 12''	18^0 36' 27''	1519	11-VII-2012
31.	Road to Donje Bare Lake	43^0 19' 25''	18^0 37' 26''	1453	11-VII-2012
32.	Donje Bare Lake	43^0 19' 05''	18^0 37' 50''	1485	11-VII-2012
33.	Drina river N of Goražde	43^0 40' 53''	19^0 08' 57''	369	12-VII-2012
34.	Pond near Sokolac, formed by small dam on the stream	43^0 56' 08''	18^0 48' 57''	881	12-VII-2012
35.	Drinjača River near Vlasenica	44^0 12' 51''	18^0 40' 10''	469	12-VII-2012
36.	Gravel pits and Drina River near Pavlović Bridge	44^0 46' 56''	19^0 20' 01''	86	13-VII-2012

Results

Altogether, we collected 357 records of 52 species from 36 localities. The list of recorded species with the locality data is presented in Table 2. Remarks on some interesting species are provided in the discussion section.

Table 2. Checklist of the Odonata species recorded during the post congress excursion of the 2nd European Congress on Odonatology (ECOO 2012) to Bosnia and Herzegovina. The references for the locality where each species was observed are given. Species listed in Annexes II and/or IV of the Habitats Directive are printed in bold.

Tabela 2. Seznam vrst kačjih pastirjev, najdenih v okviru pokongresne ekskurzije 2. evropskega odonatološkega kongresa (ECOO 2012) v Bosno in Hercegovino. Zapisu vrste je dodan seznam lokalitet, na katerih je bila vrsta najdena. Vrste, uvrščene v Prilogo II in/ali IV Habitatne direktive, so v krepkem tisku.

	Species	Number of locality
	CALOPTERYGIDAE	
1.	*Calopteryx splendens* (Harris, 1782)	2, 3, 4, 9, 12, 15-17, 19-21, 23, 24, 36
2.	*Calopteryx virgo* (Linnaeus, 1758)	3-5, 15, 16, 18-20, 22-25, 35
	LESTIDAE	
3.	*Lestes sponsa* (Hansemann, 1823)	1, 27, 29, 30, 34
4.	*Lestes dryas* Kirby, 1890	26, 27, 29, 30
5.	*Lestes barbarus* (Fabricius, 1798)	12, 25, 26, 29
6.	*Lestes virens* (Charpentier, 1825)	29
7.	*Chalcolestes parvidens* (Artobolevskii, 1929)	12, 23
8.	*Sympecma fusca* (Vander Linden, 1820)	1, 11, 12, 25, 27
	COENAGRIONIDAE	
9.	*Ischnura elegans* (Vander Linden, 1820)	1-4, 8-12, 15-17, 19, 21, 23, 25, 27, 36
10.	*Ischnura pumilio* (Charpentier, 1825)	19, 25, 27, 34
11.	*Enallagma cyathigerum* Charpentier, 1840	1, 9, 29-32, 34
12.	*Coenagrion puella* (Linnaeus, 1758)	1-3, 8, 15, 16, 19, 25-27, 29, 34
13.	***Coenagrion ornatum* (Selys, 1850)**	**16**
14.	*Coenagrion scitulum* (Rambur, 1842)	27
15.	*Coenagrion hastulatum* (Charpentier, 1825)	29, 32
16.	*Erythromma viridulum* (Charpentier, 1840)	1, 8-11, 36
17.	*Erythromma lindenii* (Selys, 1840)	2, 3, 8-10, 23
18.	*Pyrrhosoma nymphula* (Sulzer, 1776)	32, 34
19.	*Ceriagrion tenellum* (de Villers, 1789)	3, 8, 16
	PLATYCNEMIDIDAE	
20.	*Platycnemis pennipes* (Pallas, 1771)	1-6, 9, 11, 12, 16, 17, 19-21, 23, 27, 33-36
	AESHNIDAE	
21.	*Aeshna mixta* Latreille, 1805	36
22.	*Aeshna affinis* Vander Linden, 1820	2, 4, 8, 11, 19, 22, 25
23.	*Aeshna isoceles* (Müller, 1767)	3, 9, 10-12, 19, 23, 25
24.	*Aeshna grandis* (Linnaeus, 1758)	28-30, 32
25.	*Aeshna cyanea* (Müller, 1764)	7, 13, 19, 25, 29, 30, 32
26.	*Aeshna juncea* (Linnaeus, 1758)	29, 30, 32
27.	*Anax imperator* Leach, 1815	1-4, 8-10, 15-17, 19, 21, 23-25, 29-32, 34
28.	*Anax parthenope* (Selys, 1839)	1, 2, 8, 10, 11
29.	*Brachytron pratense* (Müller, 1764)	9
30.	*Caliaeschna microstigma* (Schneider, 1845)	4, 5, 6, 20, 23

	Species	Number of locality
	GOMPHIDAE	
31.	*Onychogomphus forcipatus* (Linnaeus,1758)	1, 3, 4, 6, 15-17, 20, 23, 24, 35, 36
32.	***Lindenia tetraphylla* (Vander Linden, 1825)**	**2, 8, 10-12**
	CORDULEGASTERIDAE	
33.	***Cordulegaster heros* Theischinger, 1979**	**4-7, 14, 20, 23**
34.	*Cordulegaster bidentata* Selys, 1843	19, 20, 31
	CORDULIIDAE	
35.	*Cordulia aenea* (Linnaeus, 1758)	29-32
36.	*Somatochlora metallica* (Vander Linden, 1825)	29, 30, 32
37.	*Somatochlora meridionalis* Nielsen, 1935	4
38.	*Somatochlora flavomaculata* (Vander Linden, 1825)	9-11, 25
	LIBELLULIDAE	
39.	*Libellula quadrimaculata* Linnaeus, 1758	10, 11, 25, 29-32
40.	*Libellula depressa* Linnaeus, 1758	18, 20, 25, 27, 30
41.	*Libellula fulva* (Müller, 1764)	2-4, 6, 9-12, 17, 19, 21, 23, 25, 34
42.	*Orthetrum cancellatum* (Linnaeus, 1758)	2-5, 8, 10, 11, 21, 23, 30, 32, 33, 36
43.	*Orthetrum albistylum* (Selys, 1848)	1-3, 8-11, 15, 36
44.	*Orthetrum coerulescens* (Fabricius, 1798)	2-6, 8-12, 15-17, 19, 20, 22-25
45.	*Orthetrum brunneum* (Fonscolombe, 1837)	2, 4, 6, 8, 9, 11, 15, 17-19, 24, 25
46.	*Sympetrum sanguineum* (Müller, 1764)	1, 3, 8, 24, 25, 27, 30, 34
47.	*Sympetrum flaveolum* (Linnaeus, 1758)	25-27, 29, 30, 32
48.	*Sympetrum fonscolombii* (Selys, 1840)	10, 21, 34, 36
49.	*Sympetrum striolatum* (Charpentier, 1840)	8, 12, 15, 23
50.	*Sympetrum meridionale* (Selys, 1841)	1
51.	*Crocothemis erythraea* (Brullé, 1832)	1, 2, 4, 8-12, 17, 32, 36
52.	*Selysiothemis nigra* (Vander Linden, 1825)	2-4, 6, 8-13, 15, 21, 24, 36

Discussion

During the six days of our survey, 52 species were found. Compared to 63 Odonata species reported for Bosnia and Herzegovina by Kulijer et al. (2013), our findings comprise 83% of all known dragonfly species in the country.

The commonest species were *Platycnemis pennipes* and *Anax imperator*, both found at 20 localities (56%). *Orthetrum coerulescens* was found at 19 localities (53%) and *Ischnura elegans* at 18 (50%). Seven species, i.e. *Lestes virens*, *Coenagrion ornatum*, *Coenagrion scitulum*, *Aeshna mixta*, *Brachytron pratense*, *Somatochlora meridionalis*, and *Sympetrum meridionale*, were observed at only one locality. We found 12 species in all three regions of the country. Although significant numbers of species were found during time-restricted research, the numbers of the recorded species and their abundance do not reflect the actual richness of the visited areas – especially in the Alpine and Continental parts of the country. As a consequence of short or early flight period, some of the species were either probably missed or under-recorded. *Gomphus vulgatissimus* is a common and abundant spring species in all regions of the country, and – although we visited several localities, where the species has been recorded in past years (Kulijer, unpublished data) – we failed to find a single specimen.

Some other common spring species were also quite rare: *P. nymphula* was recorded at only two localities at higher altitudes, and *B. pratense*, common species in the Mediterranean area of the country, only at Deransko Lake, where a single female was observed.

For several nationally important species, i.e. *Ceriagrion tenellum*, *Caliaeschna microstigma*, *Somatochlora metallica*, *Selysiothemis nigra*, our observations add new localities and extend their known range in the country.

Notes on selected species

At the beginning of the 20th century, Victor Apfelbeck discovered a new form of *Calopteryx* in Herzegovina and named it *Calopteryx balcanica*. After inspecting the specimens collected by Apfelbeck, Fudakowski (1930) described this form as *Calopteryx splendens balcanica*. This taxon is known only from the Balkans, where it is present in coastal areas. In Bosnia and Herzegovina, rich populations are known from karst rivers of southern Herzegovina (Kulijer et al. 2013). We were lucky to observe *C. s. ancilla* and *C. s. balcanica* together and in great abundance in their typical habitat on the Neretva and Trebižat Rivers.

The distribution of closely related *Chalcolestes parvidens* and *C. viridis* in Bosnia and Herzegovina is still insufficiently known. Recent field surveys and the revision of museum collections suggests that *C. parvidens* is much more common in the country (Kulijer et al. 2013). Our survey also supports this, as we found *C. parvidens* at two localities but none with *C. viridis*.

Until recently, *Coenagrion ornatum* was known only from the specimens stored in the collections of the National Museum in Sarajevo. Recent field surveys revealed that the species is much more common in the country, especially at richly vegetated streams and ditches in the poljes (Kulijer 2012, Kulijer et al. 2013, Kulijer unpublished data). During our survey, we found the species only at a single locality, which is most likely due to the type of visited habitats and the early flight period of the species.

Coenagrion hastulatum is one of the most interesting species found in Zelengora Mts. Bedjanič (2011) recorded the species for the first time in the country, at these lakes, a year before, in the end of June. Although the main flight period of the species usually finishes at the beginning of July, we managed to find several individuals – male and female – on Gornje Bare Lake, and a male specimen on Donje Bare Lake together with thousands of *Enallagma cyathigerum*, which made our spotting of *C. hastulatum* much more difficult. This makes the second report of the species on these lakes and in the country, confirming the presence of the local population.

The distribution of *Ceriagrion tenellum* in the western part of the Balkan Peninsula is mainly restricted to a narrow belt along the Adriatic coast (Boudot et al. 2009, Dijkstra & Lewington 2006, Kalkman 2005). In Bosnia and Herzegovina, this species is mainly known only from a small number of localities in the south (Kulijer et al. 2013). Recently, the species was also found at a small lake in central Bosnia (Kulijer, unpublished data). In Croatia, just near the border with Bosnia and Herzegovina, there are also some known populations (Bogdanović et al. 2008, Vinko 2011). During our survey, we observed the species at three

localities – of which two are new for the species and first in the Trebižat River Valley. At L 3, several adults and two tandems were found at a small shallow pond fully overgrown by bushes and trees. The species was not observed at nearby stretches of the Trebižat River with richly developed vegetation along its banks. At L 16, adults and copula were found in the dense *Carex* vegetation along the Mlade River, and also on branches and leaves of bushes and trees that fully cover a small pond in the vicinity of the river. The pond is very similar to the one at L 3.

The European distribution of *Caliaeschna microstigma* is restricted to the Balkans (Boudot et al. 2009). In Bosnia and Herzegovina, the species occurs at the western border of its range. The species inhabits springs, fast flowing streams, and small rivers of the Herzegovina region (Kulijer et al. 2013). Our observations add new data to the knowledge of the species distribution in this area. In the Trebižat River Valley, the species was quite abundant, and often found together with *Cordulegaster* sp., especially the locally dominant *C. heros*.

One of the most interesting findings was the discovery of the population of *Lindenia tetraphylla* during the boat trip on Deransko Lake (Fig. 2) and along the Krupa River – both in Hutovo Blato Nature Park. *L. tetraphylla* was mentioned for the first time for the country by Bedjanič & Bogdanović (2006). All the previous records and the species status in the country were summarized and discussed by Kulijer et al. (2013). Our observations represent the first record of a strong population of this species in the country. Although only males were seen, the large number (at least 40 males at L 10, and 30 at L 11) and the territorial behaviour suggest that the species breeds in the area. The main number of individuals was observed patrolling over Deransko jezero, which is a shallow (about 0.5 m deep) muddy-bottom lake. Some club-rush and water lilies are growing in the central part, while the lake is surrounded by a vast area of dense reed beds, and fed by small cold streams and rivers from the nearby springs. The similar habitat of *L. tetraphylla* was reported in Turkey (Kalkman et al. 2004). Many of the observed individuals were of dark – dominantly black – form (Fig. 3), which is one of the characteristics of the population of *L. tetraphylla* in the Neretva area, regarded as separate, officially still undescribed species by Bogdanović (2006). Strong permanent populations of *L. tetraphylla* are rare in Europe (Boudot et al. 2009, Dijkstra & Lewington 2006, Schorr 1998). In Croatia, several populations have been reported by Belančić et al. (2008), with the closest population inhabiting the Neretva River delta. Further investigations are needed to determine whether permanent local population exists at Hutovo Blato.

Figure 2. At Deransko Lake (L 10), numerous males of *Lindenia tetraphylla* were observed while patrolling over the lake surface (photo: D. Vinko).
Slika 2. Na površju Deranskega jezera (L 10) je bilo opaženih več teritorialnih samcev velike peščenke (*Lindenia tetraphylla*) (foto: D. Vinko).

Figure 3. Dark form of *Lindenia tetraphylla*, caught at the Krupa River (L 11) in Hutovo Blato Nature Park (photo: D. Vinko).
Slika 3. Temni samec velike peščenke (*Lindenia tetraphylla*), ujet na Krupi (L 11) v Naravnem parku Hutovo blato (foto: D. Vinko).

Two species of the genus *Cordulegaster* are present in Bosnia and Herzegovina. Although both can be found in most areas of the country, *C. bidentata* dominates in central, mountainous region, while *C. heros* prevails in the north and south (Kulijer et al. 2013). We mostly investigated *Cordulegaster* habitats in the Trebižat River Valley. *C. heros* was recorded at seven localities – all being karst springs (Fig. 4), while *C. bidentata* was found at two places. Both species, including exuviae, were found at Peč Mlini (L 20) (Fig. 5). At this locality, adults and exuviae of *C. microstigma* were also observed. Ovipositing of *C. heros* was observed downstream, while *C. bidentata* and *C. microstigma* were observed upstream.

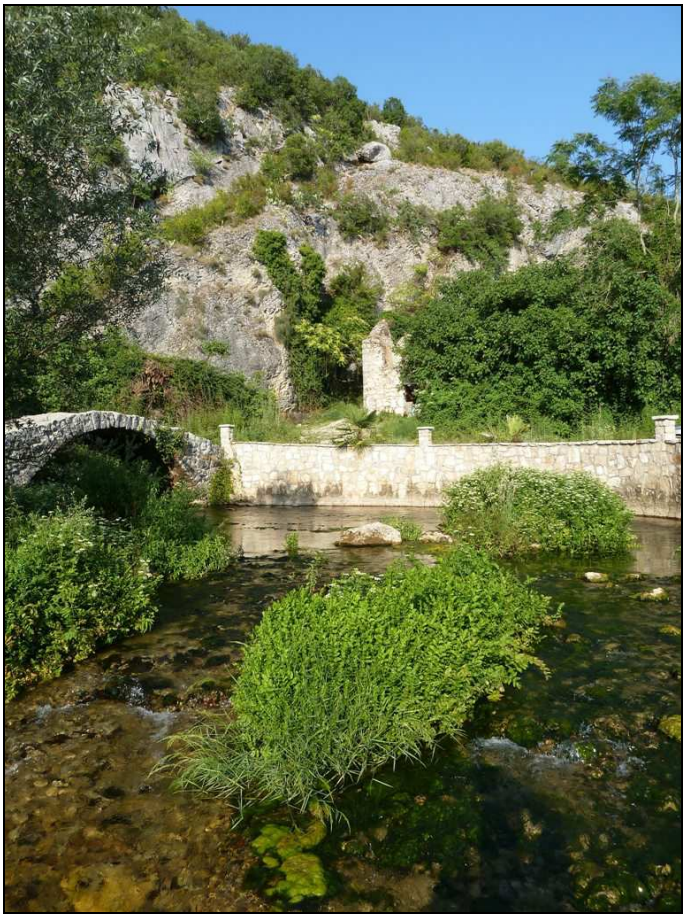

Figure 4. Karst springs and streams are typical habitat of *Cordulegaster heros* and *Caliaeschna microstigma* in South Herzegovina (photo: M. Billqvist).
Slika 4. V južni Hercegovini so kraški izviri in potoki tipični habitat za velikega studenčarja (*Cordulegaster heros*) in bledega vetrnjaka (*Caliaeschna microstigma*) (foto: M. Billqvist).

Figure 5. Karst spring of the Tihaljina River at Peč Mlini (L 20), where adults and larvae of *Caliaeschna microstigma*, *Cordulegaster heros* and *Cordulegaster bidentata* were found (photo: M. Billqvist).
Slika 5. Ob kraškem izviru na reki Tihaljini pri Peč Mlinih (L 20) so bili zabeleženi tako odrasli kot tudi ličinke bledega vetrnjaka (*Caliaeschna microstigma*), velikega (*Cordulegaster heros*) in povirnega studenčarja (*C. bidentata*) (foto: M. Billqvist).

The distribution and status of the closely related *Somatochlora metallica* and *S. meridionalis* in the country is discussed by Kulijer et al. (2013). Up until our field trip, only one record of a single male *S. metallica* had been known from Donje Bare Lake, found in 2009 (Kulijer et al. 2013). During our investigation, numerous individuals, tandems and ovipositing females were observed at Donje Bare and Gornje Bare Lakes in Zelengora Mts. This was the second record and a new locality (Fig. 6) of the species for the country, and the first time that a population of the species was observed. On the other hand, although we found it at only one locality (L 4), *S. meridionalis* is much more common – during recent surveys it has been found at more than 15 new localities (Kulijer 2012, Kulijer et al. 2013, Kulijer unpublished data).

Figure 6. Gornje Bare Lake (L 30) in Sutjeska National Park, the second discovered locality of *Somatochlora metallica* in Bosnia and Herzegovina (photo: D. Vinko).
Slika 6. Jezero Gornje bare v Nacionalnem parku Sutjeska je za Bosno in Hercegovino druga znana lokaliteta kovinskega lesketnika (*Somatochlora metallica*) (foto: D. Vinko).

The range of *Selysiothemis nigra* in Europe is restricted to the Mediterranean, where the scattered populations are mainly present in coastal areas (Boudot et al. 2009, Dijkstra & Lewington 2006). Our observations from Hutovo Blato confirm that the species is widely present in this area – as already reported by Kulijer et al. (2013). The record of *S. nigra* at Krenica Lake (L 21) in northwest Herzegovina is the westernmost for the country. Quite unexpectedly, the species was also observed at our last locality, near Pavlović Bridge in North Bosnia (L 36). From a parked car, a male imago sitting on burned vegetation was observed by D. Vinko and M. Billqvist. Even though no picture was taken and no sampling was made, it was close enough to the car to be determined with certainty. While this species is typical of the Mediterranean coast (Boudot et al. 2009), it is not suspected to be found inland. A vagrant was found 245 kilometres from the coast, in the area that is separated from the coast by high mountains and without any river flowing to the south, which is a very strange site. The record from gravel pits near Pavlović Bridge (L 36) is so not only by far the northernmost for the country, but also an interesting and rare occurrence of this species this far inland. As the species is known as a strong migrant (Boudot et al. 2009), the records from a wider area of south Herzegovina are to be expected, while the occurrence of the species at Pavlović Bridge is most likely to be just a very rare observation of a vagrant individual.

Biogeographical and conservation perspective

From a biogeographical point of view, the Dinaric Alps are one of the most important refugia in southeastern Europe that harbour interesting disjunct relict populations of several boreal dragonfly species. These habitats are insufficiently explored and potentially threatened due to effects of climate change and increasing human activity. To date, the Zelengora Mts. are the only known locality in Bosnia and Herzegovina where *Coenagrion hastulatum* and *Somatochlora metallica* have been found. Additionally, numerous lakes and ponds in this area also host what are probably the most significant populations of *Aeshna juncea* and *A. grandis* in the country (Kulijer et al. 2013). We had luck with perfect weather at both locations, where rich dragonfly communities were observed; although the lack of time and the remoteness of the mountain lakes prevented us to visit more of these interesting localities.

Records of *C. ornatum*, *L. tetraphylla*, and *C. heros* are especially interesting from the conservation point of view. These species are listed in the Annexes II and/or IV of the Habitats Directive. *L. tetraphylla* is also listed as Vulnerable (VU) in the European Red List of Odonata and *C. ornatum*, *C. heros*, *C. bidentata*, and *C. microstigma* as Near Threatened (NT) (Kalkman et al. 2010). In the Mediterranean region, *C. heros* is Vulnerable, and *C. ornatum*, *B. pratense*, *C. microstigma*, *C. bidentata*, *L. tetraphylla*, *C. aenea*, *S. metallica* are Near Threatened (Riservato et al. 2009). Additionally, several recorded species, i.e. *C. hastulatum*, *C. tenellum*, *A. grandis*, *C. microstigma*, *S. metallica* and *S. nigra*, are rare, or have restricted distribution in Bosnia and Herzegovina (Kulijer et al. 2013).

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Contribution to the knowledge of the spring butterfly fauna of the Republic of Macedonia (Lepidoptera: Papilionoidea & Hesperioidea)

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Abstract. In spring 2010, we encountered 60 butterfly species during our field surveys centred mainly in the under-surveyed southeastern part of the Republic of Macedonia. We visited 23 localities, where several interesting observations were made. Among these, new sites of some rare species such as *Pontia chloridice*, *Pieris krueperi*, *Plebejus sephirus*, *Scolitantides orion*, *Tarucus balkanicus*, *Melitaea ornata*, *Carcharodus orientalis*, and *Erynnis marloyi* should be mentioned. Such a high number of species observed indicates an overall high butterfly diversity of this region, particularly in the lower Vardar valley. Here, several specific habitats hosting rare and threatened species were discovered. The anthropogenic pressure on important butterfly habitat is still low in the surveyed area; however, the first signs of large scale abandonment are already visible.

Key words: fauna, habitat specialists, threatened species, Rhopalocera, distribution

Izvleček. PRISPEVEK K POZNAVANJU POMLADANSKE FAVNE DNEVNIH METULJEV REPUBLIKE MAKEDONIJE (LEPIDOPTERA: PAPILIONOIDEA & HESPERIOIDEA) – Spomladi 2010 smo med terenskimi raziskavami, usmerjenimi predvsem v manj raziskani jugovzhodni del Republike Makedonije, zabeležili 60 vrst dnevnih metuljev. Obiskali smo 23 lokacij in našli številne zanimive in redke vrste. Med njimi lahko posebej omenimo nova najdišča za *Pontia chloridice*, *Pieris krueperi*, *Plebejus sephirus*, *Scolitantides orion*, *Tarucus balkanicus*, *Melitaea ornata*, *Carcharodus orientalis* in *Erynnis marloyi*. Veliko število opaženih vrst v pomladanskem obdobju nakazuje visoko vrstno pestrost dnevnih metuljev tega območja, še posebej spodnjega dela doline reke Vardar. Tu smo odkrili nekaj zelo specifičnih življenjskih okolij z redkimi in ogroženimi vrstami metuljev. Antropogeni vpliv na življenjski prostor, pomemben za metulje, je na tem območju še vedno omejen, po drugi strani pa se nekatera območja velikih travniških površin pospešeno zaraščajo.

Ključne besede: favna, habitatni specialisti, ogrožene vrste, Rhopalocera, razširjenost

Introduction

Butterflies are usually one of the best studied groups of insects in countries where systematic faunistic surveys are sparse. The Republic of Macedonia is no exception with first large scale survey dating back to Rebel (1913) and Alberti (1922). A list of species with an overview of published records followed in 1964 (Thurner 1964) and in 1989, when a butterfly atlas was published by Schaider & Jakšić (1989). The grid size of the atlas is 10x10 km, which provides a good overview of butterfly distribution in the country. The negative side of the atlas is the non discriminatory use of all records, including questionable observations, making some maps misleading. Among the species not confirmed by recent surveys, the *Lycaena ottomana* (Lefèbvre, 1830), *Plebejus dardanus* (Freyer, 1844), *Erebia alberganus* (de Prunner, 1798), and *Pseudochazara graeca* (Staudinger, 1870) are the most prominent examples.

In the years that followed the atlas, several additional species were discovered (Krpač & Mihajlova 1997, Micevski et al. 2009, Thomas 1993, Verovnik & Micevski 2008, Verovnik et al. 2010), bringing the total of species known in Macedonia to 203. The list is still not complete and several additional species whose range is close to Macedonia are still expected to be found. This makes the Republic of Macedonia one of the butterfly richest countries in Europe, especially considering its small size. The main factor influencing the high diversity is the predominantly mountainous relief with several high mountain ranges and steep gorges providing microclimatic conditions for species whose range in Europe is very limited. Such regions, especially the Treska gorge, are also among the best surveyed in Macedonia, leaving relatively large areas of the country still unexplored or understudied.

The main aim of our study was to add faunistic records for spring butterflies in the sparsely surveyed south-eastern part of Macedonia. These records are particularly valuable, as spring occurring species are less studied than those flying in summer in high season for the majority of butterfly species. During our surveys we tried to cover a wide variety of habitats present in this region to provide for a complete overview of the butterfly fauna.

Material and methods

Our field survey was conducted between 24.4.2010 and 1.5.2010. In total, 23 localities were visited (Fig. 1). The selection of sites and regions with potential interesting habitat was made before the trip with the use of Google Earth images. Adult butterflies were netted using entomological nets and released after identification, or identified in nature.

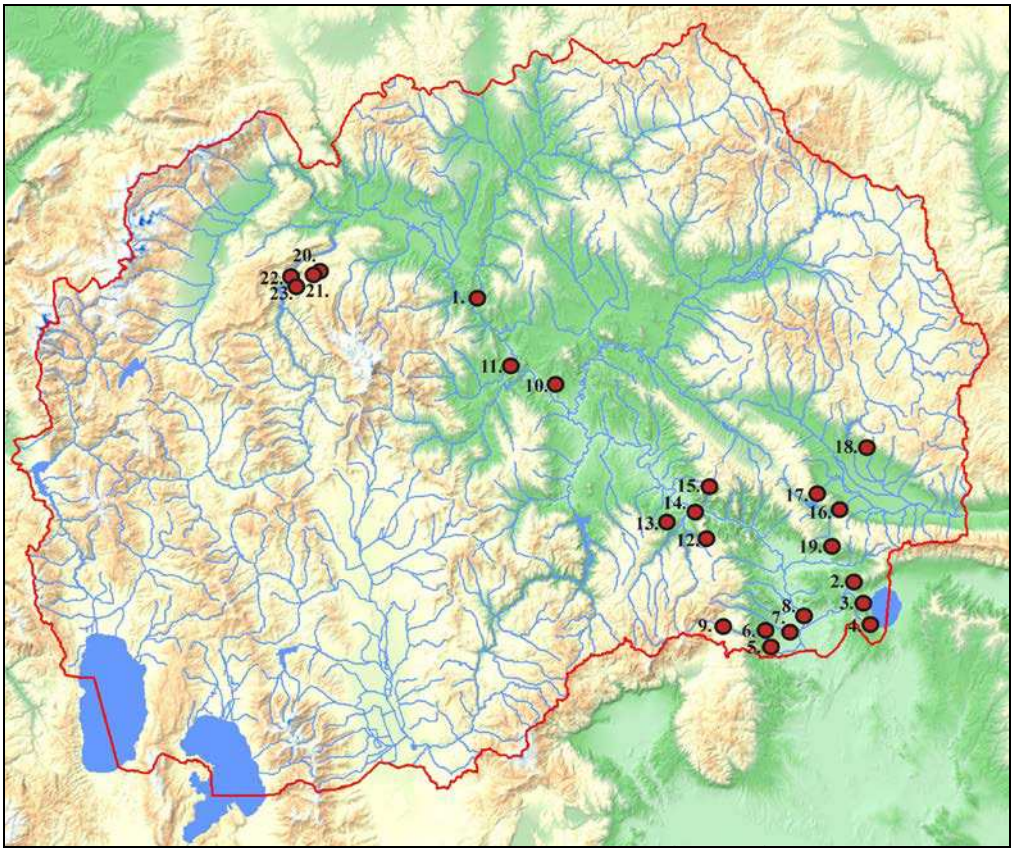

Figure 1. Distribution of visited sites during the survey of butterfly fauna in spring 2010. The numbering corresponds with the list of localities.
Slika 1. Razporeditev obiskanih lokalitet med raziskavo v Makedoniji pomladi 2010. Oštevilčenje ustreza seznamu lokalitet.

Results

List of localities

The list of localities contains the relevant toponyms, a short description of the habitat, altitude, coordinates and date of the visit. The localities are arranged in chronological order.

1. Veles, Pčinja Valley at St. Jovan monastery, path in woods and bushy slopes; 256 m; 41°49,482; 21°41,170; 24.4.2010.
2. Dojran, above Gopčeli village, small bushy gorge and pastures; 380 m; 41°15,394; 22°40,151; 25.4.2010.
3. Dojran, along the road NW of Nov Dojran, small abandoned quarry, wet meadow at a spring, rocky slopes; 165 m; 41°13,800; 22°41,685; 25.4.2010.
4. Dojran, slopes above Star Dojran, dry stony pastures, bushes, 208 m; 41°10,707; 22°42,597; 25.4.2010 and 30.4.2010.
5. Gevgelija, along Konska River at Moin village, bushy gravels, dry meadows; 120 m; 41°08,202; 22°27,110; 26.4.2010.
6. Gevgelija, E of Gorničet village, abandoned meadows, pastures with juniper bushes; 160 m; 41°08,975; 22°26,778; 26.4.2010.
7. Gevgelija, along Sermeninska River at Mrzenci village; gravels and dry bushy meadows; 75 m; 41°09,817; 22°29,652; 26.4.2010.
8. Gevgelija, along Vardar River NW of Gavato village, rocky and bushy slopes, pastures; 60 m; 41°11,893; 22°31,799; 26.4.2010.
9. Gevgelija, Gorničet, road verge E of the town, steep eroded slopes; 270 m; 41°09,973; 22°24,472; 27.4.2010.
10. Veles, Kočilari, side valleys of Vardar SE of the village, dry sandy grasslands; 160 m; 41°39,843; 21°52,551; 27.4.2010.
11. Veles, last part of Topolka Gorge, steep arid slopes with sparse grassy vegetation and bushes; 224 m; 41°41,915; 21°46,927; 27.4.2010.
12. Demir Kapija, above Dren village, meadows and abandoned pastures; 260 m; 41°21,774; 22°15,108; 28.4.2010.
13. Demir Kapija, gorge east of Besvica village, rocky and bushy slopes, dry grasslands; 260 m; 41°22,995; 22°11,413; 28.4.2010.
14. Demir Kapija, slopes N of the gorge on the S side of the river, rocky slope with sparse bushes; 180 m; 41°24,197; 22°15,491; 28.4.2010.
15. Demir Kapija, valley south of Čelavec village, pastures, woodland edges and bushes; 150 m; 41°25,107; 22°16,166; 28.4.2010.
16. Strumica, alluvium of Trkajna River south of the town; bushy gravels; 265 m; 41°24,689; 22°38,155; 29.4.2010.
17. Strumica, along the road above the valley E of Vodoča dam, woodland path, eroded slopes; 410 m; 41°25,504; 22°34,422; 29.4.2010.
18. Strumica, small valley bellow the road NW of Hamzali monastery, pastures, rocky dry meadows; 400 m; 41°30,691; 22°45,224; 29.4.2010.
19. Valandovo, dry riverbed E of the town, overgrown dry meadows on gravels; 170 m; 41°19,160; 22°36,340; 29.4.2010.
20. Mt. Suva Planina, plateau W of Nova Breznica, dry calcareous grasslands, wet meadows in the depressions;1036 m; 41°53,424; 21°14,256; 1.5.2010.

21. Mt. Suva Planina, ridge above Kozjak Lake W of Nova Breznica, screes bellow the ridge, dry calcareous grasslands, 1054 m; 41°53,320; 21°13,694; 1.5.2010.
22. Treska valley, at Kozjek Lake dam, rocky slopes; 470 m; 41°52,646; 21°11,470; 1.5.2010.
23. Treska valley, small side valley SE of the Kozjek Lake dam; steep rocky slopes and screes; 510 m; 41°52,524; 21°12,353; 1.5.2010.

List of species

Butterflies are listed in taxonomical order following the nomenclature of the Red List of European Butterflies (van Swaay et al. 2011). As butterflies were not collected and genitalia were not measured, we list *Leptidea sinapis* as *Leptidea sinapis/juvernica* species complex.

Table 1. The distribution of butterfly species observed during the spring field survey in Macedonia in 2010. The localities are numbered as in the List of localities chapter. D&S stands short for Denis & Schiffermüller.
Tabela 1. Razširjenost dnevnih metuljev, opaženih med pomladansko raziskavo v Makedoniji leta 2010. Lokalitete so oštevilčene kot v poglavju seznam lokalitet. D&S je okrajšava za Denis & Schiffermüller.

Species	Localities
Papilionidae	
Iphiclides podalirius (Linnaeus, 1758)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 19, 20, 21
Papilio machaon Linnaeus, 1758	3, 4, 5, 7, 10, 11, 16, 20, 21, 22, 23
Zerynthia cerisy (Godart, 1824)	8, 13, 15, 17
Zerynthia polyxena ([D&S], 1775)	4, 6, 7, 8, 9, 13, 15, 18, 20
Pieridae	
Anthocharis cardamines (Linnaeus, 1758)	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 15, 17, 18, 19, 20
Anthocharis gruneri (Herrich-Schäffer, 1851)	1, 11, 13, 21
Colias crocea (Geoffroy, 1785)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 17, 18, 19
Euchloe ausonia (Hübner, 1804)	2, 3, 4, 5, 7, 8, 12, 13, 15, 16, 19, 22
Euchloe penia (Freyer, 1852)	21, 22
Gonepteryx rhamni (Linnaeus, 1758)	2, 4, 9, 11, 12, 20, 23
Leptidea duponcheli (Staudinger, 1871)	10, 11, 13, 20, 21, 23
Leptidea sinapis/juvernica	1, 2, 4, 5, 6, 7, 8, 9, 12, 13, 15, 16, 17, 18, 19
Pieris balcana (Lorković, 1968)	4, 5, 15
Pieris brassicae (Linnaeus, 1758)	4, 7, 8, 11, 14
Pieris ergane (Geyer, 1828)	1, 11, 20, 21
Pieris krueperi (Staudinger, 1860)	8, 11
Pieris mannii (Mayer, 1851)	5, 9, 12, 14, 19
Pieris napi (Linnaeus, 1758)	3, 7, 8, 18
Pieris rapae (Linnaeus, 1758)	2, 3, 4, 5, 7, 8, 10, 11, 12, 13, 16, 18, 19
Pontia chloridice (Hübner, 1813)	5, 7
Pontia edusa (Linnaeus, 1758)	4, 7, 10, 11, 15
Lycaenidae	
Aricia agestis ([D&S], 1775)	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 13, 15, 16, 17, 18, 19
Callophrys rubi (Linnaeus, 1758)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 23
Celastrina argiolus (Linnaeus, 1758)	4, 5, 6, 7, 8
Cupido minimus (Fuessly, 1775)	11, 23
Cupido osiris (Meigen, 1829)	2, 4, 5, 13
Glaucopsyche alexis (Poda, 1761)	1, 2, 3, 4, 6, 7, 9, 10, 11, 12, 13, 15, 16, 17, 18, 22, 23
Lycaena phlaeas (Linnaeus, 1761)	1, 2, 4, 5, 7, 8, 9, 10, 11, 13, 16, 18
Lycaena tityrus (Poda, 1761)	2, 4, 6, 7, 8, 10, 11, 16, 18
Plebejus sephirus (Frivaldzky, 1835)	13
Polyommatus bellargus (Rottemburg, 1775)	11

Species	Localities
Lycaenidae (continued)	
Polyommatus icarus (Rottemburg, 1775)	2, 4, 5, 6, 7, 9, 10, 11, 12, 13, 15, 17, 18, 19, 22, 23
Polyommatus thersites (Cantener, 1835)	2, 4, 10, 11, 13, 17
Pseudophilotes bavius (Eversmann, 1832)	23
Pseudophilotes vicrama (Moore, 1865)	4, 5, 6, 7, 8, 9, 10, 11, 13, 16, 20
Scolitantides orion (Pallas, 1771)	16, 17
Tarucus balkanicus (Freyer, 1844)	10, 11, 13
Nymphalidae	
Aglais io (Linnaeus, 1758)	1, 8, 10, 12
Coenonympha pamphilus (Linnaeus, 1758)	3, 4, 6, 7, 8, 9, 10, 11, 16, 17, 19
Issoria lathonia (Linnaeus, 1758)	1, 2, 4, 6, 7, 8, 13, 15, 16, 18, 19, 20, 23
Lasiommata megera (Linnaeus, 1767)	2, 3, 4, 5, 6, 7, 11, 12, 13, 15, 16, 17, 18, 19
Libythea celtis (Laicharting, 1782)	2, 8, 11, 13, 15, 18
Limenitis reducta (Staudinger, 1901)	4, 6, 8, 13, 15
Melitaea cinxia (Linnaeus, 1758)	1, 4, 6, 9, 13, 17
Melitaea ornata Christoph, 1893	2, 4, 10, 11, 13, 14, 17, 18
Melitaea trivia ([D&S], 1775)	11
Nymphalis antiopa (Linnaeus, 1758)	1, 8, 10, 11, 14
Nymphalis polychloros (Linnaeus, 1758)	1, 13
Pararge aegeria (Linnaeus, 1758)	6, 8, 11, 13, 15
Polygonia c-album (Linnaeus, 1758)	8, 10, 13
Vanessa atalanta (Linnaeus, 1758)	4, 11, 13, 16, 17, 18
Vanessa cardui (Linnaeus, 1758)	2, 4, 5, 7, 8, 9, 10, 11, 13, 15
Hesperidae	
Carcharodus alceae (Esper, 1780)	2, 4, 8, 10, 11, 12, 20, 23
Carcharodus orientalis Reverdin, 1913	2, 4, 13, 19
Erynnis marloyi (Boisduval, 1834)	13, 23
Erynnis tages (Linnaeus, 1758)	2, 10, 11, 12, 13, 15, 17, 20
Pyrgus armoricanus (Oberthur, 1910)	2, 4, 11, 13, 15, 18, 19
Pyrgus malvae (Linnaeus, 1758)	6, 9, 12, 13, 15, 16, 17, 20
Pyrgus sidae (Esper, 1784)	17
Spialia orbifer (Hübner, 1823)	4, 7, 9, 10, 12, 13, 16, 19

Discussion

In many cases, the early spring butterfly fauna is less studied compared to the peak season in June or July, especially in the countries where faunistic data are published mainly by foreign authors. The Republic of Macedonia is no exception, therefore distribution of several species with flight period limited to the spring is not well known. In order to fill this gap, we surveyed large part of the country, but stayed mostly in the warmer lowland regions where diversity of butterflies was expected to be higher in early season. Thus we concentrated on the surveys of the Vardar Valley and wider surroundings of Lake Dojran. A total of 60 species observed is extremely high for the survey in the last week of April and it could be attributed to the early season due to favourable weather conditions in spring 2010.

The commonest species during the survey was *Callophrys rubi*, which was recorded at 21 sites. It is interesting to note that its recorded distribution in Macedonia is rather patchy (Schaider & Jakšić 1989). It was recorded from many new squares during our survey. As this is an exclusively early spring occurring species, our records indicate its much wider distribution in Macedonia. Among the species normally not flying in April, the following early records are interesting: *Plebejus sephirus*, *Polyommatus bellargus*, *Melitaea trivia* and *Pyrgus sidae*. We paid special attention to specific habitats during our surveys, where rare and local butterfly species were expected to be found. These are dealt with in detail bellow:

- *Pontia chloridice* – It is a habitat specialist utilizing sites with regular disturbance enabling its host plant *Cleome ornithopodioides* to grow (John et al. 2008). It was observed at two sites on gravels along streams near Gevgelija. These finds and its occurrence in Macedonia have been recently reviewed by Franeta et al. (2011).
- *Pieris krueperi* – Another habitat specialist limited to warm rocky gorges. We found it in the Topolka valley, from where it had already been reported by Thurner (1964), and at a new site north of Gevgelija on the rocky slopes above the Vardar River at Gavato village. This is the first record of the species from the lower part of the Vardar Valley in Macedonia.
- *Plebejus sephirus* – This is a predominantly mountainous species in the southern part of the Balkan Peninsula. The presence of a single male in the gorge east of Besvica village to the south from Demir Kapija was therefore a big surprise. The larvae of this species are feeding on *Astragalus* sp., possibly on *A. excapus* in Macedonia (Tolman & Lewington 2008). Non-flowering plants of an unidentified *Astragalus* were observed on dry sandy meadows at the site.
- *Scolitantides orion* – According to Schaider & Jakšić (1989), the species is rare in Macedonia and mainly limited to the western part of the country. It is again a habitat specialist utilizing screes and rocky areas, where its host plants *Sedum* sp. are growing. We found it on wide gravels SE of Strumica and on eroded slopes along the path at Vodoča dam. These are the first records from SE part of Macedonia.
- *Tarucus balkanicus* – The species has a very limited range in Macedonia with records scattered mainly in the southern half of the country (Schaider & Jakšić 1989). We found it in the Topolka Valley, where it had already been discovered by Thurner (1964), and at two new sites at nearby Kočilari in the Vardar Valley further south from the Topolka and in the gorge east of Besvica village near Demir Kapija.
- *Melitaea ornata* – This species was first mentioned for Macedonia by Verovnik et al. 2010 under the name *Melitaea telona*. Due to its morphological resemblance to a more widespread but not closely related *M. phoebe* (Leneveu et al. 2009), the status of *M. telona* was disputed until recently. Currently it has been confirmed that it is conspecific with and is a junior synonym of *M. ornata* from the European part of Russia south of the Urals (Tóth & Varga 2011, Tóth et al. 2012). Although the species can be identified safely only by adult larvae and their ecology (Russell et al. 2007), typically marked adults can also be provisionally assigned to one or another species. Additionally, the early occurrence in April is a good indication for *M. ornata*, as *M. phoebe* usually starts to fly from mid-May onwards (Tolman & Lewington 2008). We found putative *M. ornata* specimens with typical external characteristics at 8 new sites covering almost the entire surveyed area from the Strumica Valley in the east, to Lake Dojran and the middle part of the Vardar valley. The search for larval stages and host plants will be required to precisely delimit the distribution of *M. ornata* in Macedonia, and our records provide a good starting point for such surveys.

- *Carcharodus orientalis* – Due to its resemblance to *Carcharodus flocciferus* (Zeller, 1847), this is another poorly studied species in Macedonia. We found it at four sites, three in the wider surroundings of Lake Dojran and in Demir Kapija in the Vardar Valley. These records provide a further extension of the species' known range in Macedonia.
- *Erynnis marloyi* – This species reaches its northwestern limit in Macedonia and is therefore extremely rare and local, limited to the warmest regions, where it is usually confined to rocky gorges. This corresponds well with both sites, where it has been recorded during recent surveys. A single specimen was seen both in the gorge east of Besvica village near Demir Kapija and in the Treska Valley in a small gorge at Kozjek Lake dam.

Based on the recent European Red List of Butterflies (van Swaay et al. 2010), only two of the observed species *Zerynthia cerisy* and *Pseudophilotes vicrama* are listed as near threatened at the continental level. Both are widespread in Macedonia (Schaider & Jakšić 1989) and possibly locally not threatened. *Zerynthia cerisy* actually prefers a certain degree of habitat disturbance and it is commonly observed near or even within villages, where the host plant *Aristolochia clematitis* is growing (pers. observ.). Following the Red List of Butterflies for the Macedonian Republic (Krpač & Darcemont 2012), several additional threatened species found during our survey are listed: *Erynnis marloyi* (NT), *Zerynthia polyxena* (NT), *Euchloe penia* (VU), *Pieris krueperi* (NT), *Pontia chloridice* (VU), *Tarucus balkanicus* (NT), *Pseudophilotes bavius* (VU), and *Scolitantides orion* (NT). This assessment should, however, be considered tentative, as for many of the listed species the distribution and habitat requirements in Macedonia are not sufficiently known to allow designation of threat categories. *Pseudophilotes bavius*, for example, has been reliably recorded only from two sites in Macedonia (Thurner 1964) and not confirmed at Veles site in recent decades. The abundance of adults in the Treska-Matka Gorge has been steadily declining during last two decades due to overgrowing (pers. observ.) and it is not unlikely that the species is on the verge of extinction in Macedonia. Its presence at Kozjek Lake dam further upwards in the Treska Valley provides some hope it is still surviving in other localities along the river.

Once again, Macedonia has proved to be one of the most interesting counties for butterflies in Europe. Our survey provides a good overview of the spring butterfly fauna of the southeastern part of the country. However, only a more systematic approach targeting all under-surveyed area would be required to fully understand the species distribution and endangerment. We hope this contribution will be seen as a step in this direction.

Figure 2. The Inky Skipper (*Erynnis marloyi*), a rare species in Macedonia, was found at two sites during the survey (photo: Rudi Verovnik).
Slika 2. Sivček vrste *Erynnis marloyi* je v Makedoniji redka vrsta. Našli smo ga na dveh novih lokacijah (foto: Rudi Verovnik).

Figure 3. The Krueper's Small White (*Pieris krueperi*) is confined to hot rocky gorges in Macedonia (photo: Rudi Verovnik).
Slika 3. Sivček vrste *Erynnis marloyi* je v Makedoniji redka vrsta. Našli smo ga na dveh novih lokacijah. (foto: Rudi Verovnik)

Figure 4. The gorge east of the village Besvica was one of the most interesting localities with 37 species observed, including rare species like: *Plebejus sephirus*, *Tarucus balkanicus*, *Melitaea ornata*, *Carcharodus orientalis*, and *Erynnis marloyi* (photo: Barbara Zakšek).
Slika 4. Soteska vzhodno od vasi Besvica je bila ena izmed najbolj zanimivih obiskanih lokacij. Tu smo našli 37 vrst metuljev, med njimi tudi redke vrste: *Plebejus sephirus*, *Tarucus balkanicus*, *Melitaea ornata*, *Carcharodus orientalis* in *Erynnis marloyi* (foto: Barbara Zakšek).

Povzetek

Med 24. aprilom in 1. majem 2010 smo opravili raziskavo dnevnih metuljev pretežno v jugovzhodnem delu Makedonije. Obiskali smo 23 lokalitet in skupno zabeležili 60 vrst dnevnih metuljev. To je za tako zgodnji termin izjemno veliko število vrst, kar lahko pripišemo ugodnim vremenskim razmeram v tem delu Evrope leta 2010. Posebno pozornost smo namenili posebnim življenjskim prostorom, kjer smo pričakovali nekatere redke vrste dnevnih metuljev. Tako smo na prodiščih v okolici Gevgelije našli izjemno redkega predstavnika rodu selcev *Pontia chloridice*. Zanimive so tudi soteske, ki so v Makedoniji pogosto izrazito skalnate in tople. Tu smo med drugim našli nekatere redke in ogrožene vrste metuljev, kot so *Erynnis marloyi*, *Euchloe penia*, *Pieris krueperi*, *Tarucus balkanicus*, *Pseudophilotes bavius* in *Scolitantides orion*. Predvsem *Pseudophilotes bavius* je vrsta, ki ji zaradi zaraščanja grozi izumrtje v Makedoniji. Nova najdba te vrste pri akumulacijskem jezeru Kozjek v soteski Treske daje upanje, da se vrsta skriva še kje v nedostopnih delih te doline. Gledano v celoti je favna dnevnih metuljev Makedonije še vedno zelo površno raziskana. V prihodnje bi se bilo smiselno teh raziskav lotiti bolj sistematično in pregledati vsa slabo raziskana območja. Naš prispevek je korak v tej smeri in upamo, da jih bo sledilo še več.

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New records of the golden jackal (*Canis aureus* L.) in the upper Soča valley, Slovenia

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Abstract. Golden jackals (*Canis aureus*) have been recorded in the Slovenian Julian pre-Alps for more than 50 years. In recent years, however, a substantial increase in sightings of golden jackalshas been recorded in the area around the town of Bovec. During the present study we gathered information through interviews with local hunters and other residents and conducted a basic questionnaire on their opinion about this expanding carnivore. In addition, we performed monitoring of jackals with the use of acoustic playback method, photo-traps and searching for footprints and other signs of jackal presence. We also reviewed the database of the reported jackal depredations on livestock at the Bovec Forest Service. In total, we conducted 31 interviews and gathered information on 100 records of jackal presence from 2009 to 2012. The questionnaire showed a negative attitude toward jackal among local hunters. Using acoustic methods, we were unable to confirm the presence of a territorial jackal group, but we did detect jackals on 26 photographs made with photo-traps at one location. During the study, two jackals were killed by car and we collected tissue samples for potential future genetic analysis. Official records of depredations showed high increase in assumed jackal attacks on sheep, but we could not confirm if or how many of these depredations were actually caused by jackals. Further studies are needed to understand the real extent of jackal predation on domestic and wild ungulates, as well as the origin and development of this new jackal group(s) in the Julian pre-Alps.

Key words: golden jackal, *Canis aureus*, photo-trapping, acoustic method, monitoring, Bovec, Slovenia

Izvleček. NOVI PODATKI O POJAVLJANJU ZLATEGA ŠAKALA (*CANIS AUREUS* L.) V ZGORNJI SOŠKI DOLINI – Najstarejši podatki o pojavu zlatega šakala (*Canis aureus*) v Julijskih Predalpah so znani izpred več kot 50 let. V zadnjih nekaj letih pa se je predvsem v okolici mesta Bovec število opažanj šakalov močno povečalo. V raziskavi sva zbrala podatke prek intervjujev s člani lokalnih lovskih družin ter nekaterimi drugimi domačini. Z anketo sva tudi ugotavljala, kakšno je njihovo mnenje o šakalu. Terensko delo je obsegalo izzivanje oglašanja šakalov s predvajanjem posnetkov, nastavljanje samosprožilnih kamer ter iskanje sledi in drugih znakov prisotnosti te vrste. Pregledali smo tudi arhiv zabeleženih škod na drobnici, ki ga vodi krajevna enota Zavoda za gozdove. Opravljenih je bilo 31 intervjujev, prek katerih smo zbrali 100 različnih lokacij šakala med letoma 2009 in 2012. Rezultati ankete so pokazali negativen odnos do pojava šakala na Bovškem. Z metodo predvajanja posnetkov oglašanja nam ni uspelo zabeležiti odziva, zato pa nam je pa pojavljanje šakalov uspelo potrditi z uporabo foto-pasti, in sicer na 26 posnetkih z ene lokacije. Med raziskavo sta bila na območju povožena tudi dva šakala, kar smo izkoristili za odvzem tkiva za morebitne nadaljnje genetske raziskave. Uradni podatki napadov na drobnico velik delež pripisujejo šakalu, a je trenutno težko oceniti, v kolikšni meri je te napade dejansko povzročil šakal. Za realno oceno obsega napadov na drobnico in divjad so potrebne tarčne raziskave, prav tako glede izvora in širjenja šakala v Julijskih Predalpah.

Ključne besede: zlati šakal, *Canis aureus*, foto-pasti, izzivanje oglašanja, monitoring, Bovec, Slovenija

Introduction

The golden jackal population in Europe recently successfully expanded from the Balkan region towards Central and Eastern Europe (Arnold et al. 2012). Golden jackals are believed to have been spreading towards Slovenia and the Italian region of Friuli–Venezia Giulia from Dalmatia via the Istrian peninsula (Kryštufek & Tvrtković 1990, Lapini et al. 2009). The oldest record of jackal presence in Slovenia is from the winter of 1952/53, when two individuals were shot near Vrhnika and one near Kobarid in the Upper Soča valley in the Julian pre-Alps (Mehora 1953, Brelih 1955). Confirmed data on the presence of territorial families in Slovenia so far exist only for Ljubljansko barje in central Slovenia (Krofel 2009).

After the jackal was shot at Kobarid in the 1950s, very few records of jackal presence were reported from NW Slovenia. In Italy, the oldest data on jackal presence is from the province of Udine in 1985 (Lapini et al. 1988, 2009, 2011), but in recent years more data have been gathered (Lapini et al. 2011). Also, in recent years several sightings of golden jackals have been claimed in the area around the town of Bovec in Slovenia. The oldest reliable data on jackals in the Bovec valley is from 2006 (Lapini et al. 2009). Following the increasing number of jackal sightings, several sensationalistic articles were published in the national media (e.g. Dnevnik and www.siol.net). Unil now, these new records have not yet been collected and no systematic study has been done to determine the present status of golden jackals in this area. In this study, we gathered all available information about new occurrences of jackals in the Julian pre-Alps and conducted systematic surveys using acoustic playback methods and opportunistic photo-trapping sessions. In addition, a short human-dimension survey was conducted to measure attitudes towards jackals by hunters of the Bovec area.

Study area and methods

The survey took place in the Bovec valley, a wide alpine glacier valley in NW Slovenia with an approximate elevation of 400 m a.s.l. (46°20'N, 13°33'E). The Soča river with its meanders created a diverse environment with willows (*Salix* spp.) as the main vegetation on its banks. The surrounding forests are mainly composed of common beech (*Fagus sylvatica*), hornbeam (*Carpinus betulus*) and Norway spruce (*Picea abies*). The total human population in the Bovec valley barely exceeds 2,000, with considerably higher numbers during the summer tourist season. Besides tourism and industry, sheep breeding is an important part of the local economy. The area has a Mediterranean-like climate with relatively mild winters, often almost without snow, even though the valley lies at the doorstep of the Julian Alps.

The first part of the study was based on interviews with local hunters and other inhabitants. We focused on getting information on sightings, vocalizations, tracks and other signs of jackal presence. A short human-dimension survey that consisted of four statements about jackals in the Bovec area was also included in the interviews with hunters – members of the four local hunting societies (LD Bovec, LD Čezsoča, LD Log pod Mangrtom and LD Soča). The interviews were mostly conducted at peoples' homes, some also via e-mail or telephone.

All members of the local hunting societies were invited to participate in the questionnaire, even though only a few had any previous contact with jackals. Therefore, more people participated in the questionnaires (41) than the total number of interviews conducted (31). Except for one case, all of the hunters were males. Seven local residents that had a contact with jackals were also interviewed, but were not included in the questionnaire.

The Bovec Forest Service keeps a record of attacks on livestock by predators in the region. Their archive for the past five years was examined due to a widely spread belief that golden jackals are the main source of attacks on sheep. We studied the archives for depredations by all predators from 2007 to 2011. Data from 2007 to 2009, when no depredations caused by jackals were recorded, were used for comparison to observe trends in depredations by other predators.

The acoustic playback method (Giannatos et al. 2005, Krofel 2008a, b, 2009) was conducted twice, i.e. on 21.11.2011 and 2.3.2011 in the evening time. The sky was clear, without wind, with temperatures near 0 ^{o}C. It is estimated that jackals would be able to respond from a distance of maximum 2 km (Giannatos et al. 2005); therefore six calling stations were chosen to cover the greater part of the Bovec valley. The locations were selected on the basisof data gathered from the hunters and in combination with landscape features that would allow for optimal sound transmission. The howl recordings were broadcasted for 30 seconds, followed by a 5 min break for listening. This was repeated five times.

The automatic photo-trap cameras were set up on locations, where photos of jackals with pups had previously been taken by hunters. We used Boly Guard SG550V 5MP Infrared and Bushnell Sentry 5MP night vision cameras. Bait with a strong smell was used to attract the carnivores.

Results

In 31 conducted interviews, we gathered 100 records of jackal presence (Table 1, Figure 1). Except for photographs, none of these records could be confirmed by material or some other evidence.

Table 1. Data on jackal presence gathered amongst hunters and other residents.
Tabela 1.

	Σ 2009	Σ 2010	Σ 2011	Σ 2012*
Sightings	2	14	32	9
Howlings	0	1	22	3
Photographed	0	6	0	5
Tracks	0	2	0	2
Excrements	0	2	0	0
Total	2	25	54	19

* For 2012, the survey was completed by June.

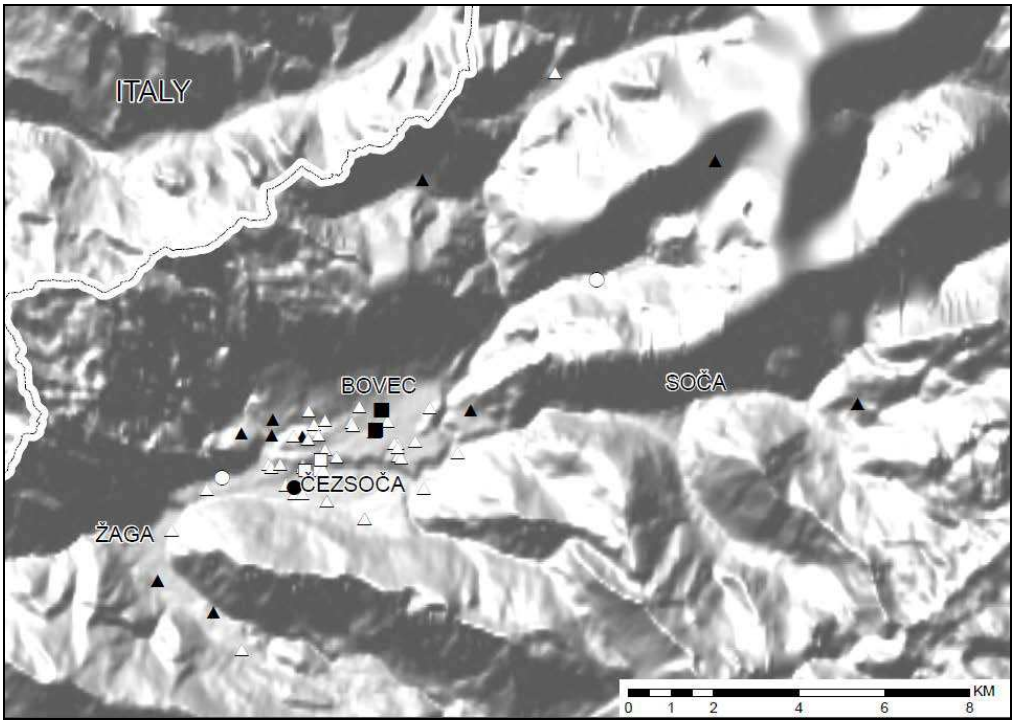

Figure 1. Map representing records of golden jackal (*Canis aureus*) presence in the Bovec valley in 2009-2012: direct observations (white triangles), howling (black triangles), scats (white circles), footprints (black circles), photographs (white squares), dead jackals (black squares).
Slika 1.

Some of the most interesting information is presented here:

- In 17 cases, there were sightings of pups.
- The closest meeting with a jackal was claimed to be in three cases from a distance of about 5 m.
- The highest location of a jackal was 950 m a.s.l. (howling).
- In 2011, it was claimed that a Šarplaninec dog killed two jackals while protecting a herd of sheep.
- In June 2011, a local hunter claimed to have spent one hour observing a family of 13 jackals (8 cubs, 3 sub-adults and 2 adults).
- In July 2011, a local resident claimed to have observed 2 jackals killing a roe deer fawn (*Capreolus capreolus*).

Forty-one hunters participated in the questionnaires and they represent 24% of all members of four local hunting societies (Table 2).

Table 2. Results of the questionnaire on hunters' attitude toward golden jackals conducted among hunters (n= 41) from four local hunting societies in the Upper Soča valley.
Tabela 2.

	Strongly disagree	Disagree	Hard to say	Agree	Strongly agree
»Jackals have a positive impact on the natural environment in Bovec.«	67%	14%	14%	5%	0%
»Jackals are not native of our region, therefore it would have been better if they had never appeared.«	23%	2%	12%	19%	44%
»Jackal populations in Slovenia need to be regulated by shooting.«	2%	0%	9%	14%	75%
»Very little is known about jackals in Slovenia. «	7%	2%	21%	21%	49%

The majority of hunters would prefer that jackals had never appeared in the region and they support the intention of shooting the animals. They also largely agreed with the statement that there is a deficit of knowledge about jackals in Slovenia and the majority disagreed that jackals have a positive effect on the natural environment in the Bovec valley.

We analysed records of sheep depredations provided by the Bovec Forest Service (Table 3, Figures 2 and 3). They indicated that 91% of the attacks were attributed to golden jackals, 2% to brown bears (*Ursus arctos*) and 7% to Eurasian lynx (*Lynx lynx*). The total number of recorded attacks was 40.

Table 3. Age structure of sheep assumed to be killed by golden jackals in 2010 and 2011.
Tabela 3.

	Adult sheep	Lambs	Σ
Number of attacks	17	25	40*
Percent	40.5%	59.5%	
Number of killed animals	22	40	62
Percent of killed animals	35.5%	64.5%	
Average number of killed animals per attack	1.3	1.6	

*In two cases, sheep and lambs were killed together, so we regard it as a single attack.

In 2010, the number of reported attacks on sheep by predators doubled compared to 2009 (Figure 2) and the number of killed animals almost tripled.

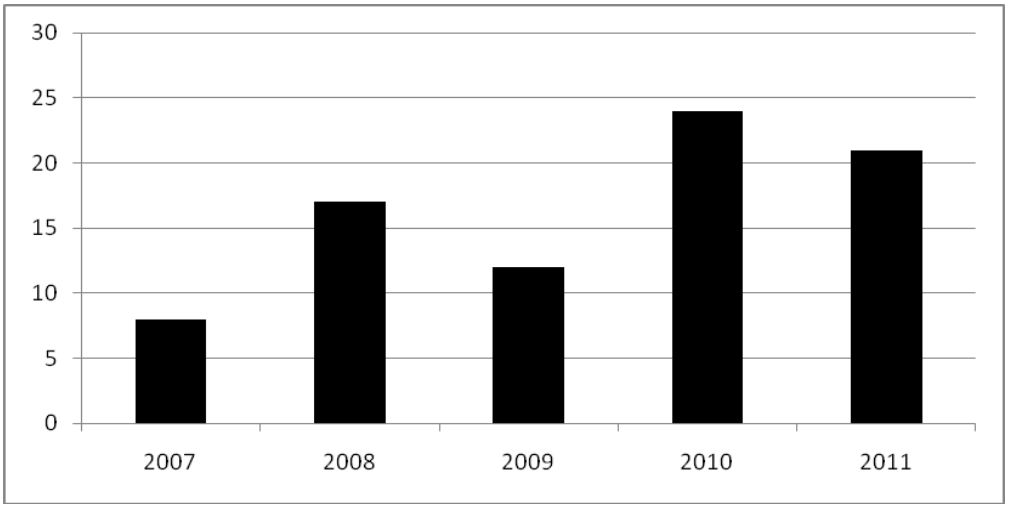

Figure 2. Number of attacks on sheep by all protected species of predators recorded by the Bovec administrative unit of the Slovenia Forest Service from 2007 to 2011.
Slika 2.

In the years from 2007 to 2009, there were on average 16 killed animals per year from predators that were determined not to be golden jackals (brown bear, lynx, raven [*Corvus corax*]), or 13 attacks per year (more than one animal could be killed per attack). After golden jackals became part of the official Slovenia Forest Service records in 2010 and 2011, this average of depredations caused by other predators decreased to 3.5 killed animals, or 2 attacks on average per year, which is 4.5 and 6.5 times less, respectively (Figure 3).

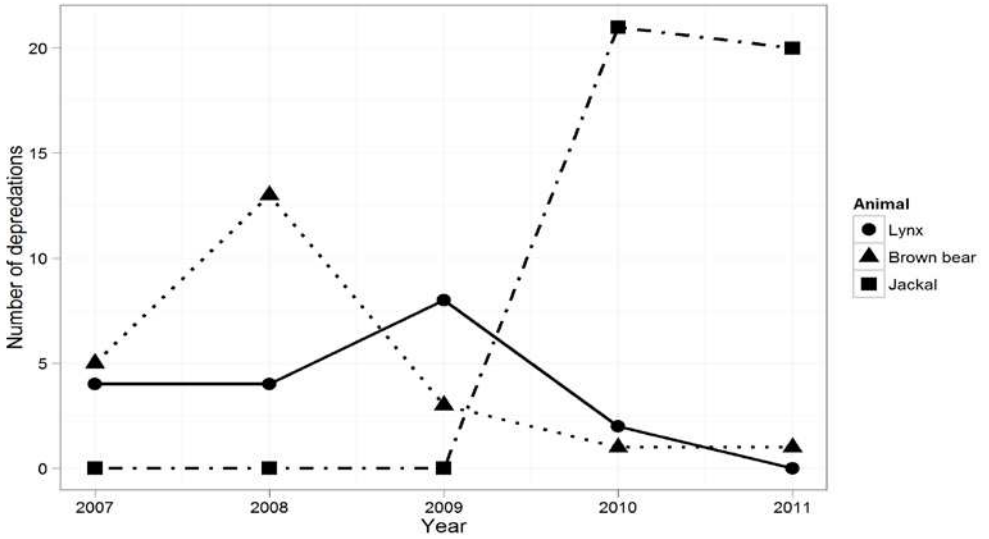

Figure 3. Numberof recorded depredations of sheep attributed to Eurasian lynx, brown bear and golden jackal in the Upper Soča Valley from 2007 to 2011.
Slika 3.

We did not record any response to the 42 playbacks of jackal howling in any of the nights.

In March and April 2012, we used a single photo trap, set at three different locations. In total we kept it running for 21 days. At one location we photographed a single adult jackal for four consecutive days from April 22nd to April 25th (Figure 4). Based on its appearance, we believe that we were dealing with the same individual.

At two occasions (6th of March and 18th of March 2012) we found jackal tracks along the Soča river (Figure 5). According to the size of the footprint (length: 5.5 cm), we assume it was an adult individual.

In 2012, two jackals were killed by car. The first accident occurred on April 24th on the Bovec ring road. The killed male jackal weighed 15.2 kg and was estimated to be 2–3 years old. The second road-kill happened on the 13th of June, near the village Idrsko, about 22 km down the Soča valley from Bovec. It was a year old male weighing 10.5 kg. In both cases, tissue samples were collected for genetic analysis.

Figure 4. An adult golden jackal photographed on the bank of the Soča river near Bovec using a photo-trap (Photo: Miha Mihelič, 22nd April 2012).
Slika 4.

Figure 5. Jackal footprint in the mud along the Soča river (Photo: Miha Mihelič, 6th of March, 2012).
Slika 5.

Discussion

Two golden jackals killed by car, 26 photographs made with photo-traps and two records of jackal tracks in the mud were recorded in the Upper Soča valley during this survey. In addition, we collected information on 100 observations of jackal presence from hunters and local inhabitants, including photographs of jackal pups. These new data confirm that at least one territorial family has formed in the Bovec valley in the recent years. This has also become the second region after Ljubljansko barje in Slovenia where reproduction has been confirmed.

The longest distance between jackal records in the Bovec valley was 16 km. According to data from Greece, the only region in Europe where a telemetry study on jackals has been conducted so far, the home range size of golden jackals oscillates between 2 and 15 km^2 (Giannatos, 2004). This suggests that more than one jackal family group could be present in the Bovec valley. However, this cannot be confirmedas yet, since it is possible that some of the records refer to dispersing individuals. Also, the majority of records come from an area of 14 km^2, which could correspond to one home range, especially when considering that home range sizes of jackals in the Slovenian pre-Alps region could be larger than in primer habitats of Greece. Nevertheless, further studies (e.g. genetic analysis of non-invasive samples or telemetry study) would be needed to reliably determine the number of different jackal groups and animals. Lack of response to surveys with the acoustic playback method is probably due to a low density of jackals in the area (potentially only one territorial family group). In areas with a higher density of territorial families, the animals constantly use howls to maintain the borders of their territory, therefore they respond with a much higher rate compared to families in areas with low density (Giannatos 2004, Krofel 2008b). Jackal pups have been sighted 17 times, always within the same area along the Soča river. Therefore we believe that they were part of the same family.

According to the data on jackal occurrences in Friuli–Venezia Giulia (Lapini et al. 2011), a region in NE Italy that borders on western Slovenia, it seems likely that jackals that became established in the Bovec valley originate from the Julian pre-Alps in NE Italy, which in turn probably originate from NW Croatia. However, genetic analysis would be required to confirm these hypotheses. In 2011 and 2012, jackals were seen several times on Mt. Matajur and in Idrsko near the town of Kobarid, and a young male was killed by car in 2012 near Idrsko. Whether these were dispersers that originated from the Bovec family group (or any other), is currently unknown. But it could be an indication that some of the jackals from the Bovec valley have started dispersing and that new territorial families could become established in the region in the future.

The number of recorded attacks on sheep has increased by 61% from 2009 to 2010. It is possible that the jackal family that was first photographed in 2010 could have partly contributed to the increase in attacks on sheep, but at present this cannot be confirmed. According to official records, the jackal depredations started in 2010 and continued in 2011. What is unusual is that in this period official numbers also show a substantial decrease in sheep depredations attributed to other predators (i.e. brown bear and Eurasian lynx). The currently used method to determine the predator is based on the location and appearance of wounds, feeding signs and other signs of presence. However, this approach has limited

reliability, at least compared to other methods (e.g. genetic analysis of saliva from bite wounds). Therefore, some mistakes in the interpretation might be possible, especially as there is no obvious reason for a drastic decline in attacks by brown bear and Eurasian lynx after 2010. It is also not clear why jackal depredation would start only in 2010, although they have been present in the Bovec valley since 2006. Surprisingly, the Forest Service's archive also does not contain any data on attacks by red fox or domestic dogs, although it is known that these two animals have been attacking sheep in this region in the past (M. Krofel et al., unpublished data). Our assumptions are supported by preliminary genetic analysis. So far six genetic samples of saliva from wounds on sheep that were recorded as being killed by jackals were analysed at the Biotechnical Faculty, Department of Biology. In three cases the laboratory results showed presence of the red fox (*Vulpes vulpes*), which was likely the cause of the attack. In three other samples no canid DNA was detected. Jackals were thus not detected in any of the case analysed (T. Skrbinšek & M. Jelenčič, unpublished data).

Erroneous data on the identity of a predator and sensationalistic reports by the media can have a strong negative impact on attitudes towards predators by sheep breeders and the general public. In combination with the general opinion that jackals are not native to the Upper Soča valley, these beliefs can increase the incentive for poaching and demands for legal removal of animals. For example, the widespread belief that jackals caused most of the attacks on sheep in 2010, led the local Union of Sheep Herders to petition the Slovenian Environment Agency to allow the reduction of the jackal population in the Bovec valley. This, however, was later rejected. In Slovenia, golden jackal has been a protected species since 2004 and can only be killed with a special permission (Ur. l. RS 46/2004). So far, no jackals have been legally killed in Slovenia since their protection. The same is true for Italy, where jackals have been protected since 1997 (Lapini et al. 2011).

We recommend genetic analysis to be performed for future potential jackal attacks on livestock in order to reliably determine the frequency of depredations by jackals. In other countries, even in areas with high jackal and sheep density (e.g. in Greece), attacks on sheep by jackals are minimal (Giannatos 2004). In interviews, some hunters argued that presumed attacks on sheep occur because some sheep herders do not protect their animals effectively enough. Some claimed this was even on purpose, so farmers could receive certain compensations. Some interviewees also reported at least four illegal sheep carcass dumps, owned by the sheep herders, which also supposedly attracted jackals. Jackals are known to regularly use such anthropogenic food sources when available (Yom-Tov et al. 1995). According to the two cases reported in 2011, livestock guard dogs efficiently protected a flock of sheep and were claimed to have even killed two jackals that had approached the sheep.

The questionnaire showed that local hunters have a negative attitude toward jackals and their impact on the environment, mainly because of the common opinion that jackals are responsible for the decline in the roe deer population. Others believed that this decline was just part of fluctuations due to other causes. In general, reports on jackals attacking larger mammals are extremely rare and are much more common in other jackal species (e.g. the black-backed jackal [*Canis mesomelas*]; Krofel 2007, 2008c) than in golden jackal. In general, predation on ungulates by jackals is supposed to be mainly focused on weak individuals and neonates.

In contrast to golden jackal, only 14% of Slovenian hunters had negative attitude toward grey wolf (*Canis lupus*) (Marinko & Majić Skrbinšek 2011), although this species has a considerably stronger effect on wild ungulates. We suggest that the reason is in fact that wolves have been constantly present in Slovenia before the arrival of people, while jackals colonized this region relatively recently. In addition, negative attitudes toward jackals in Bovec could be linked with many hunters regarding them as alien and invasive species. It should be noted that jackals colonized Slovenia from its historic range in the Balkan Peninsula naturally, without being introduced by people, like some other species, e.g. racoon dog (*Nyctereutes procyonoides*), coypu (*Myocastor coypus*), mouflon (*Ovis ammon*), fallow deer (*Dama dama*), and pheasant (*Phasianus colchius*). However, it is possible that humans could have indirectly influenced recent golden jackal expansion in Europe, especially by exterminating grey wolves from many parts of Europe that were consequently colonized by jackals.

The majority of hunters also agreed that little is known about jackals, and this lack of knowledge probably again contributed to their negative attitudes, as is often observed in human-dimension studies on large carnivores (e.g. Korenjak 2000). Lack of knowledge and reliable data on jackal ecology in Slovenia contributes to various polemics and misbeliefs about their numbers, depredations and effects on other wildlife. Our survey has shed some light on the jackal status in NW Slovenia. To improve the knowledge on jackal status in the Julian pre-Alps, more international cooperation is needed, as this part of the population is likely trans-boundary. A detailed study on depredations and potential impacts on the roe deer population is also greatly needed in order to produce a basis for appropriate and science-based management of this potentially conflict species.

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New records of the rare dragonfly, Black Pennant – *Selysiothemis nigra* (Vander Linden, 1825) (Insecta: Odonata) in Bosnia and Herzegovina

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Abstract. In 2012, we recorded a Black Pennant, *Selysiothemis nigra*, at two sites in Bosnia and Herzegovina, i.e. in the surroundings of Klepci village and in Hutovo Blato Nature Park, Neretva River. These are the first recent records of this species in Bosnia and Herzegovina, which had previously been known only from the entomological collection in the Museum of Sarajevo. As this species had previously been recorded on the Croatian side of the Neretva River, these records fit into the distribution area of the species. With the confirmation of this record, the dragonfly fauna of Bosnia and Herzegovina consists of 60 species.

Key words: dragonflies, *Selysiothemis nigra,* distribution, Neretva, Bosnia and Herzegovina

Izvleček. NOVE NAJDBE TEMNEGA SLANIŠČARJA, *SELYSIOTHERMIS NIGRA* (VANDER LINDEN, 1825) (INSECTA: ODONATA), V BOSNI IN HERCEGOVINI – V teku leta 2012 je bil zabeležen temni slaniščar, *Selysiothemis nigra*, na dveh lokacijah v Bosni in Hercegovini v okolici vasi Klepci in Naravnega Parka Hutovo Blato, reka Neretva. To sta v Bosni in Hercegovini prvi nedavni najdbi te vrste, ki je bila prej poznana iz entomološke zbirke muzeja v Sarajevu. Najdba je znotraj znanega areala vste, ki je bila predhodno zabeležena na hrvaški strani reke Neretve. S potrditvijo te najdbe šteje favna kačjih pastirjev Bosne in Hercegovine 60 vrst.

Ključne besede: kačji pastirji, *Selysiothemis nigra*, razširjenost, Neretva, Bosna in Hercegovina

Introduction

Bosnia and Herzegovina is a western Balkan country, situated between Croatia in the west and Serbia and Montenegro in the east. Like its name indicates, it consists of two regions, the northern part called Bosnia and the southern part called Herzegovina. It is a mountainous country, with the large part of the country occupied by the Dinaric Mountain chain. The southern part, Herzegovina, is under a strong influence of the Mediterranean Sea, which can be seen particularly in the faunal composition of this region regarding different animal groups (e.g. butterflies (Lelo 2007)).

While the first data on the dragonfly fauna of Bosnia and Herzegovina were published more than 100 years ago (Petrović et al. 1891), the dragonfly fauna of Bosnia and Herzegovina is still insufficiently known. In the past few decades, limited odonatological attention has been devoted to the country, due to war circumstances. Several minefields still persist, which do not enable systematic surveys to be carried out in the country.

In the last overview of dragonflies of Bosnia and Herzegovina (Jović et al. 2010), 57 species were recorded, 6 of them for the first time ever. Jović et al. 2010 also predicted that ten additional species would be recorded in the near future, due to the known distribution range in the surrounding countries. This proved to be true for the two additional species recorded recently for the country: *Anax parthenope* (Selys, 1839) (Sućeska & Karačić 2011) and *Coenagrion hastulatum* (Charpentier, 1825) (Bedjanič 2011). Still, Bosnia and Herzegovina remains one of the least studied countries in terms of dragonfly distribution and number of records (Jović et al. 2010).

Material and methods

We visited the Bosnian part of Neretva River on two occasions, 8.7.2012 and 6.8.2012. Additionally, the data collected from three localities in Croatia between 4.-7.7.2012 are also included. Dragonflies were collected with the butterfly net and released on the same spot. The specimens' determination was done using Dijkstra & Lewington (2006).

Localities in which the species was recorded:

Bosnia and Herzegovina

1. Klepci, near Čapljina, N 43.088617, E 17.718767, 8.7.2012, 2F
2. Hutovo Blato Nature Park, N 43.070767, E 17.750383, 6.8.2012, > 20 M & F

Croatia

3. Dubravica, 1 km northwest from the village, N 43.028350, E 17.643433, 5.7.2012, 3 M
4. Blace, 1 km northwest from the village, N 43.021917, E 17.490967, 4.7.2012, 2M, 1 F
5. Kamp Rio, Opuzen, N 43.015819, E 17.467575, 6.8.2012, 4 M, 3 F

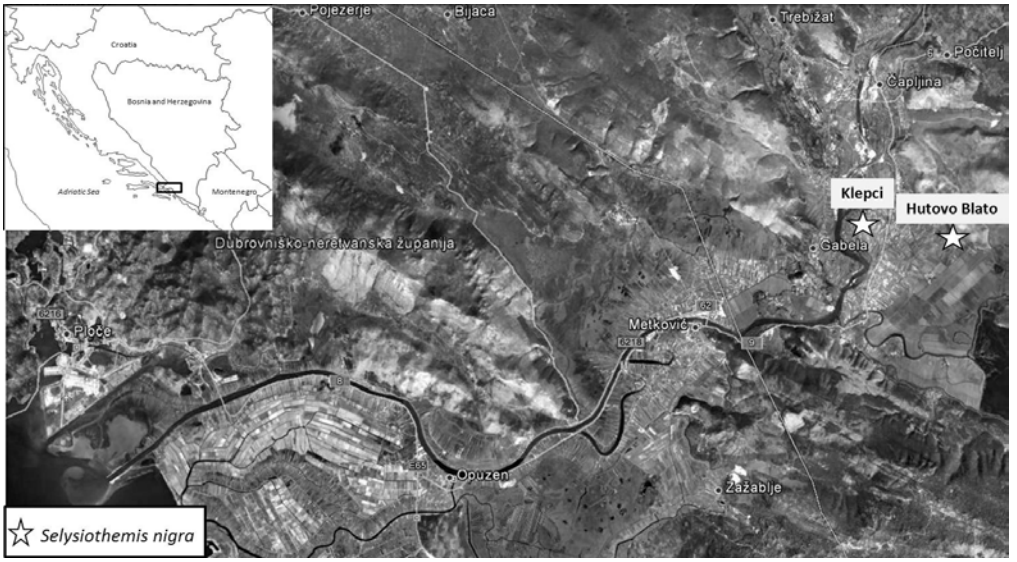

Figure 1. Map of the Neretva River with the marked records of *S. nigra* in Bosnia and Herzegovina and Croatia.
Slika 1. Zemljevid reke Neretve z označeno najdbo *S. nigra* v Bosni in Hercegovini in na Hrvaškem.

Results and discussion

In the first locality, a single dragonfly species, Black Pennant, *Selysiothemis nigra* (Vander Linden, 1825), was recorded. Two females were collected in dry grassy area near the village. The meadows in which they were recorded are surrounded by a small river and ponds, which represent an ideal habitat for this species (Dijkstra & Lewington 2006). The same species was again recorded in the area of Hutovo Blato Nature Park, some 3 kilometres southeast from the first locality. The habitat there consisted of swamps, path edges and maquis. Both male and female *S. nigra* were flying around in great numbers, and occasionally resting on bushes and branches. More than 20 specimens were observed in a half hour period. Such high number of observed specimens indicates that the population of this species in this locality is numerous, and the habitat favourable.

This species is distributed mainly in Central Asia and in the Middle East, with scarce distribution in the Mediterranean. It is active from May, until August or September (Dijkstra & Lewington 2006). Few additional species were recorded in the locality of Hutovo Blato, and are listed here to improve the knowledge of dragonflies of Bosnia and Herzegovina: *Sympetrum fonscolombi* (Selys, 1840), *Orthetrum coerulescens* (Fabricius, 1798), *Crocothemis erythraea* (Brullé, 1832) and *Ischnura elegans* (Vander Linden, 1820).

After the review of all recent data of dragonflies of Bosnia and Herzegovina (Jović et al. 2010, Bedjanič 2011, Sućeska & Karačić 2011), we concluded that no published records exist for *S. nigra* for Bosnia and Herzegovina. However, it was given to our attention that some specimens of this species are stored in the Zemaljski muzej of Bosnia and Herzegovina in Sarajevo and that the paper with existing records of this species had already been submitted for publication (Kulijer et al. in press). And while our records are not the first records for the country, they are important as they represent first recent records of this species in Bosnia and Herzegovina.

According to Jović et al. (2010), its occurrence in the Mediterranean part of the country was expected due to the records made in Croatia (Belančić et al. 2008) and Montenegro (Jović et al. 2008). In Croatia, it was also recorded across the Neretva River (Bogdanović et al. 2008), so this record only fits into the known range from Croatia toward the Bosnian part of the river. Our recent observations from the Neretva river (Fig. 1) confirm that this species is present as well as very numerous and widespread in the Croatian part of the Neretva. Further surveys of the Bosnian part of the Neretva River and surrounding localities will probably reveal more localities for this species. With the records of this species, the dragonfly fauna of Bosnia and Herzegovina consists of 60 species.

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The westernmost Slovenian record of Common Glider *Neptis sappho* (Pallas, 1771) (Lepidoptera: Rhopalocera)

NAJZAHODNEJŠA NAJDBA MALEGA KRESNIČARJA NEPTIS SAPPHO (PALLAS, 1771) (LEPIDOPTERA, RHOPALOCERA) V SLOVENIJI

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The range of the Common Glider (*Neptis sappho*) stretches from the eastern part of Asia to the eastern part of Italy (Gorica region) (Tolman & Lewington 2009). In Slovenia, it has a disjunct distribution (Jutzeler et al. 2000). It is more widespread in the east, especially in NE Slovenia. In the western part of its range, it is limited to the lower part of the Soča and Vipava Valleys (Verovnik et al. 2012). It usually has two generations, with sporadic occurrence of third generation in warmer areas of its distribution. In Slovenia, adults are on the wing from the end of April until mid-September (Verovnik et al. 2012). Most commonly used larval host plants in Europe are *Lathyrus niger* and *Robinia pseudacacia* (Jutzeler et al. 2000). Both are widespread and common in Slovenia (Jogan et al. 2001) and are not a limiting factor for distribution of the Common Glider. Due to the utilization of the invasive tree *Robinia pseudacacia*, which is widespread in Slovenia, the Common Glider is possibly still expanding its range and is therefore not considered threatened (Verovnik et al. 2012).

During a short visit of the Nadiža Valley on 3rd August 2012, a Glider was spotted flying along the river bank under the Napoleon Bridge near Logje village (GKY: 379956; GKX: 121705). When it settled on a rock, it was clear that it had two parallel white bands on the hind wings and was therefore recognized as the Common Glider. This species was first found in the upper Soča valley in 2005 by Zakšek (2006) near one of the small streams flowing into the Soča south of Kobarid. This is approximately 15 km away from the newly discovered site. It is still unclear how the species reached this part of Slovenia. One possibility could be through the Nadiža Valley from Italy, where the closest record of this species comes from San Pietro al Natisone, 12 km to the south (Jutzeler et al. 2000).

The Nadiža Valley under Logje village should suit the Common Glider (Fig 1). However, during that day no larval host plant was seen in the vicinity of the river bank, therefore the presence of a larval habitat and permanent local population at that site should be further investigated.

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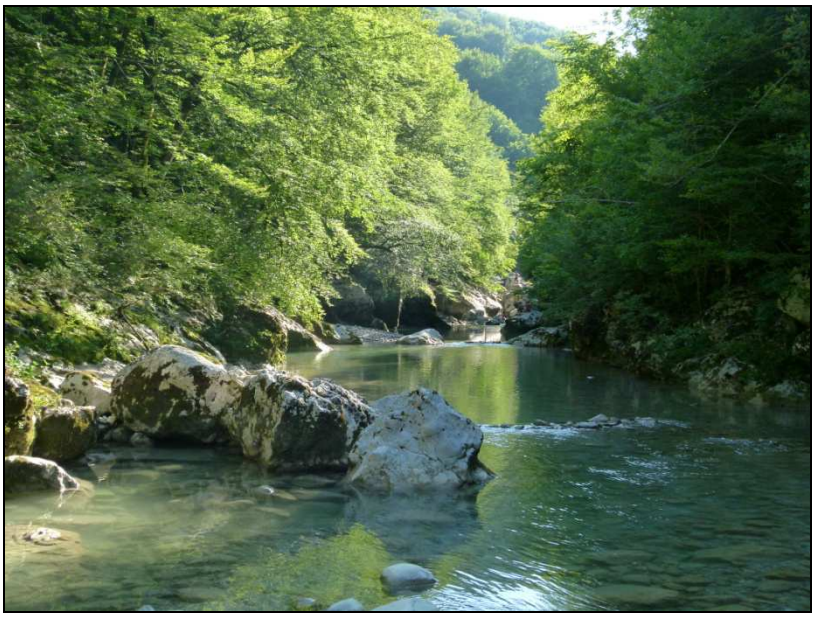

Figure 1. Nadiža valley near Logje village, where Common Glider *Neptis sappho* was observed (photo: Vid Švara).
Slika 1. Dolina Nadiže pod vasjo Logje, kjer je bil opažen mali kresničar *Neptis sappho* (foto: Vid Švara).

First record of a grass snake *Natrix natrix* (Linnaeus, 1758) in Postojnska jama

PRVA NAJDBA BELOUŠKE *NATRIX NATRIX* (LINNAEUS, 1785) V POSTOJNSKI JAMI

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Reports on snakes found in caves in temperate regions are rare, which is not surprising, considering that snakes activity is related to ambient temperature (Gould & Keeton 1996). In the time of snakes' inactivity during the winter, temperate caves may represent suitable shelters for hibernation, as it was reported in several cases from North America (Drda 1968, Sexton & Hunt 1980). In tropics, on the other hand, snakes may use caves as shelters from high outside temperatures (Hobbs 2012) or they visit them for feeding (Humphreys 2012, Deharveng & Bedos 2012), either at the cave entrances, where they feed on emerging bats or birds (Esbérard & Vrcibradic 2007, Humphreys 2012), or in deeper cave zones to feed on bats (Herrid 1962, Cary 1981), birds (Price 2003, Waltham & Despain 2012), cave crickets (Brode 1958), and mice (Holman 1958). Yet, some species are reported to probably spend the whole life underground, e.g. the long tailed blind snake *Ramphotyphlops longissimus* (Aplin 1998) from the Barrow Island karst (Humphreys 2012) or Ridley's beauty snake *Orthriophis taeniurus ridleyi* (Butler, 1899) from Malaysia and Thailand. The latter can live only in caves feeding on bats and swiftlets, and even has reduced pigment (Price 2003).

In Slovenia, two reports on snakes found in caves have been published. In Škocjanske jame, a juvenile Aesculapian snake *Zamenis longissimus* (Laurenti, 1768) was found in November 2001, around 150 m from the cave entrance, where it was most likely hibernating (Koselj & Zagmajster 2001). The second report concerns Desna jama v Kalcah (probably Jama 2 v kamnolomu Drenov grič), where an adult grass snake *Natrix natrix* (Linnaeus, 1758) was found in June 2002, only 5 m deep from the cave entrance (Zazula 2003). Here we report on the third finding of a snake in a cave, with the greatest distance from the cave entrance reported so far in Slovenia.

On the 22nd of August 2012, an adult grass snake was found in the Spodnji Tartar part of Postojnska jama, which is about 600 m downstream the Pivka river from the entrance to Postojnska jama and about 400 m upstream from the entrance to Otoška jama. The snake was motionless on stones at least 2 m away from the standing water. This standing water body was within the bed of the Pivka river, but due to the low water levels it was away from the river current. The ambient temperature at the time of finding was not measured, but according to Šebela & Turk's (2011) measurements in different parts of Postojnska jama it was probably close to the interval 9.9 – 11.4 °C. Temperature of the Pivka river measured about 100 m upstream was 15.0 °C. The grass snake was in a seemingly poor body condition; it had loose skin on the rear half of its body and remains of an old injury on the left eye. We collected the individual and released it about six hours later in the surface Pivka river, 250 m upstream from the cave entrance. After its release, the snake swam in the river without any visible problems.

Grass snake is distributed in almost all Europe (Gasc et al. 1997) and is the commonest snake species in Slovenia, distributed from lowland to hilly areas of Slovenia, with the exception of high mountainous regions of the Alps (Krofel et al. 2009). The presence of the grass snake in Postojnska jama could have been a result of different events. The snake could get into the cave passively, i.e. washed in by the water current of the Pivka river. In the time of sampling, the water level was low (about 0.053 m/s 100 m from the entrance to Postojnska jama), yet even in these conditions it would take only about three hours for the snake to be washed to the locality were it was found. The other possibility would be that the individual was washed in when the water levels were greater and currents stronger. In the first part of 2012, precipitation was lower than average (Razdrto Meteorological Station, ARSO 2012), so such event would have to take place at least half a year ago. As the snake was found outside water, its completely passive input by water current to the point of finding is not very likely. The snake could also come into the cave actively, for

example, while searching for shelter from hot temperatures in the surface - in August 2012, the maximum daily temperatures exceeded 29°C (Postojna Meteorological Station, ARSO 2012). Later it could get confused and arrived so deep in the cave accidentally. The possibility of the snake coming into the cave actively for feeding purposes seems very unlikely, as the ambient temperatures inside the cave were low for the snake's active hunting. The possibility of the snake being brought to this part of the cave by a human is practically unfeasible, since this part of the cave is situated far from the general tourist route. We can conclude that the presence of grass snake so deep in Postojnska jama was an uncommon and accidental event.

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Figure 1. Fotografija belouške, najdene v Postojnski jami. Foto: Mateja Deržič.
Slika 1. Photo of a grass snake found inside Postojnska jama. Foto: Mateja Deržič.

First Slovenian record of a nursery colony of Natterer's bats *Myotis nattereri* (Kuhl, 1817) in a tree

PRVA SLOVENSKA NAJDBA PORODNIŠKE KOLONIJE RESASTIH NETOPIRJEV *MYOTIS NATTERERI* (KUHL, 1817) V DREVESU

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Although the Natterer's bat *Myotis nattereri* is generally distributed in Slovenia (Jazbec 2009), its roosts and hibernacula are found very rarely indeed. In Central and Northern Europe, Natterer`s bats nursery colonies were regularly formed in tree holes or cracks of various buildings, while in the Mediterranean region species usually bred in rock crevices (Dietz et al. 2009). Only three colonies of Natterer's bat are known in Slovenia, and all of them have been found in buildings, two of them in the walls and one in a bridge crevice (Jazbec 2009). Two nursery colonies were discovered in SW part of Slovenia in 2002: two females with juveniles in Rihemberk Castle and another female with a juvenile in the crevice of a stone bridge at Spodnja Branica (Jazbec 2009). In both of these smaller roosts bats were observed in the ensuing years (CKFF 2012). In 2007, the largest known nursery colony of Natterer's bats in Slovenia was found in a wall crack at Vnanje Gorice (central Slovenia) with 30 females and their young (Zagmajster 2008).

On 26th July 2012, during bat research carried out within the Biology Students Research Camp »Pivka 2012«, we discovered a nursery colony of Natterer's bats in a tree. We accidentally noticed some bat droppings on the ground next to the approximately 15 m tall small-leaved lime (*Tilia cordata*), which is situated in front of the Church of Sveti Jurij in the middle of the settlement of Ilirska Bistrica in the SW part of Slovenia (Gauss-Krueger coordinates: Y=441676, X=47038). The tree is surrounded by residential area with some orchards, tall trees, gardens and, in the east, by a stream that flows between the church and 200 m distant mixed wood, which extends towards the east into a larger forested area. In a branch of the small-leaved lime, approximately 7 metres above the ground, we found a bat roost with three different entrances: two rounded (d=5 cm) from the side and one crack (3×10 cm) from the top (Fig. 1). We managed to take two individuals out of the tree hollow by hand. We recorded their sex, age category on the basis of epiphysis ossification (Anthony 1990) and their reproductive status (Haarsma 2008). Measurements of their forearm length (AB) using calliper and body mass (m) using Pesola spring scale (60 g) were taken. Both a lactating female (AB=40.4 mm, m=7.5 g) and a juvenile male (AB=37.2 mm, m=6.0 g) were determined as Natterer's bats (Dietz & von Helversen 2004). The female had a white patch of fur on the head, above and on the side of the right eye (Fig. 2). This is considered as a case of leucism, condition of partial lack of fur pigmentation, which is frequently observed in all bat species (Haarsma 2008).

Although eight bats flew out of the roost during our attempt to take the bats out of the hole by hand to determine their sex and species, most of the bats still remain in the roost. After visual inspection of the roost we were able to see at least 10 individuals and to determine them on the basis of their appearance: long and light coloured ears with long tragus and typical S-shaped spur on tail membrane (Dietz & von Helversen 2004). Initially, there were at least 20 specimens hiding in the roost, which is consistent with records from Central Europe where colonies usually consist out of 20-50 animals, in buildings also over 120 (Dietz et al. 2009). Our observations confirm that this is a nursery colony of the Natterer's bat.

The roost in Ilirska Bistrica is the first known nursery colony of a Natterer's bat in a tree in Slovenia. Findings of bat roosts in trees are most often accidental, as systematic and thorough inspection of potential roosts in trees requires more effort and time than inspection of other types of roosts (e. g. church attics and caves). Different potential roosts in trees are also more numerous and often hardly accessible for proper inspection. Survey of tree holes can be conducted

with boreoscope or endoscope, which enables detailed inspection of usually narrow hollows, or with evening observation of potential roosts for emerging bats. Use of radio-telemetry methods can also reveal bat's day roosts in trees. The suggested methods should be used more often in the future for additional records of nursery colonies of bat species that roost in trees, since the information on them contributes to valuable ecology and distribution knowledge.

Acknowledgement

We are thankful to Primož Presetnik for providing useful information on literature and data from the Database of the Centre for Cartography of Fauna and Flora. We would like to thank the kind people living next to the church for lending us a ladder and making the inspection of the roost possible.

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Figure 1. Two rounded openings (d=5 cm) leading into the tree branch of a small-leaved lime *Tilia cordata,* in Ilirska Bistrica, SW Slovenia, in which the nursery colony of Natterer's bat *Myotis nattereri* was found (photo: Aja Zamolo).
Slika 1. Okrogli stranski odprtini (d=5 cm), ki vodita v vejo lipovca *Tilia cordata*, v Ilirski Bistrici, JZ Slovenija, v kateri je bila najdena porodniška kolonija resastih netopirjev *Myotis nattereri* (foto: Aja Zamolo).

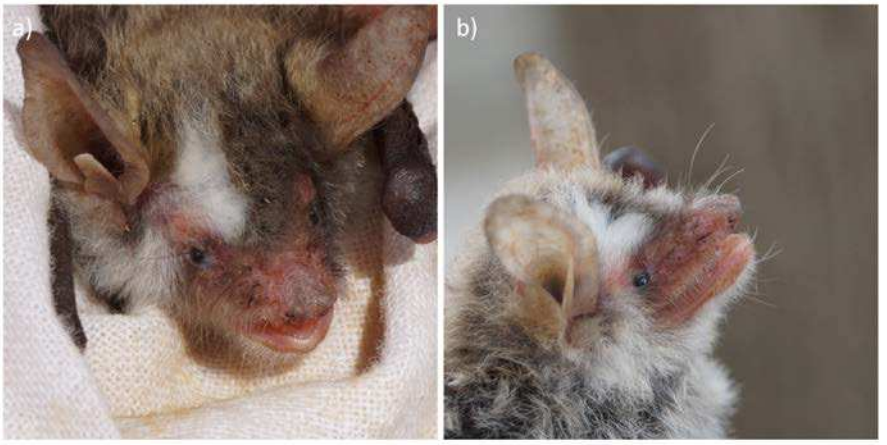

Figure 2. Portraits of leucistic Natterer's bat *Myotis nattereri* female, which was found in the tree roost in Ilirska Bistrica; a) frontal and b) lateral views (photo: Aja Zamolo).
Slika 2. Portret levcistične samice resastega netopirja *Myotis nattereri* iz zatočišča v drevesu v Ilirski Bistrici; a) pogled od spredaj in b) stranski pogled (foto: Aja Zamolo).

NAVODILA AVTORJEM

NATURA SLOVENIAE objavlja izvirne prispevke, ki imajo za ozadje terensko delo s področja biologije in/ali prispevajo k poznavanju favne in flore osrednje in jugovzhodne Evrope. Prispevki so lahko v obliki znanstvenih člankov, kratkih vesti ali terenskih notic.

Znanstveni članek je celovit opis izvirne raziskave in vključuje teoretično ozadje tematike, območje raziskav in metode uporabljene pri delu, podrobno predstavljene rezultate in diskusijo, sklepe ter pregled literature. Dolžina naj ne presega 20 strani.

Kratka znanstvena vest je izvirni prispevek, ki ne vsebuje podrobnega teoretičnega pregleda. Njen namen je seznaniti bralca z delnimi ali preliminarnimi rezultati raziskave. Dolžina naj ne presega petih strani.

Terenska notica je krajši prispevek o zanimivih favnističnih ali floristističnih opažanjih in najdbah na področju Slovenije. Dolžina naj ne presega treh strani.

Vsi prispevki bodo recenzirani. Avtorji lahko v spremnem dopisu sami predlagajo recenzente, kljub temu pa urednik lahko izbere tudi kakšnega drugega recenzenta. Recenziran članek popravi avtor oz. avtorji sami. V primeru zavrnitve se originalne materiale skupaj z obrazložitvijo glavnega urednika vrne odgovornemu avtorju.

Prispevki, objavljeni v reviji Natura Sloveniae, ne smejo biti predhodno objavljeni ali sočasno predloženi in objavljeni v drugih revijah ali kongresnih publikacijah. Avtorji se s predložitvijo prispevkov strinjajo, da ob njihovi potrditvi, ti postanejo last revije.

Prispevke lahko oddate na naslov Natura Sloveniae, Oddelek za biologijo Univerze v Ljubljani, Večna pot 111, 1111 Ljubljana, Slovenija, (telefon: (01) 423 33 88, fax: 273 390, E-mail: rok.kostanjsek@bf.uni-lj.si).

FORMAT IN OBLIKA PRISPEVKA

Prispevki naj bodo napisani v programu Word for Windows, v pisavi "Times New Roman CE 12", z levo poravnavo in 3 cm robovi na A4 formatu. Med vrsticami naj bo dvojni razmak, med odstavki pa prazna vrstica. Naslov prispevka in naslovi posameznih poglavij naj bodo natisnjeni krepko v velikosti pisave 14. Latinska imena rodov in vrst morajo biti pisana ležeče. Uredniku je potrebno prispevek oddati v primerni elektronski obliki (disketa, CD, elektronska pošta) v Rich text (.rtf) ali Word document (.doc) formatu.

Naslov prispevka (v slovenskem in angleškem jeziku) mora biti informativen, jasen in kratek. Naslovu naj sledijo celotna imena avtorjev in njihovi naslovi (vključno z naslovi elektronske pošte).

Izvleček v slovenskem jeziku mora na kratko predstaviti namen, metode, rezultate in zaključke. Dolžina izvlečka naj ne presega 200 besed za znanstveni članek oziroma 100 besed za kratko znanstveno vest. Pod izvlečkom naj bodo ključne besede, ki predstavljajo področje raziskave. Njihovo število naj ne bo večje od 10. Sledi abstract in key words v angleškem jeziku, za katere velja enako kot za izvleček in ključne besede.

Glavnina prispevka znanstvenega članka in kratke znanstvene vesti je lahko pisana v slovenskem jeziku čeprav je bolj zaželjen angleški jezik. Prispevek, ki je pisan v slovenskem jeziku mora vsebovati obširnejši angleški povzetek - summary, prispevek pisan v angleškem jeziku pa obširnejši slovenski povzetek (200-500 besed). Terenska notica je v celoti napisana v angleškem jeziku, brez izvlečka, ključnih besed in povzetka. Pri oblikovanju besedil naj se avtorji zgledujejo po zadnjih številkah revije.

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Skupno število slik in tabel v prispevku naj ne bo večje od 10, njihovo mesto naj bo v članku nedvoumno označeno. Posamezne tabele z legendami naj bodo na ločenih listih. Naslovi tabel naj bodo nad njimi, naslovi slik in fotografij pa pod njimi. Naslovi in legenda slik in tabel naj bodo v slovenskem in angleškem jeziku. Pri navajanju slik in tabel v tekstu uporabljajte okrajšave (npr. angl: Tab. 1 ali Tabs. 1-2, Fig. 1 ali Figs. 1-2 in slo.: Tab. 1 in Sl. 1).

NAVAJANJE LITERATURE

Navajanje literature v besedilu mora biti na ustreznem mestu. Kadar citiramo enega avtorja, pišemo Schultz (1987) ali (Schultz 1987), če sta avtorja dva (Parry & Brown 1959) in če je avtorjev več (Lubin et al. 1978). Kadar navajamo citat večih del hkrati, pišemo (Ward 1991, Pace 1992, Amman 1998). V primeru, ko citiramo več del istega avtorja objavljenih v istem letu, posamezno delo označimo s črkami (Lucas 1988a, b). Literatura naj bo urejena po abecednem redu.

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Lubin Y.D., Eberhard W.G., Montgomery G.G. (1978): Webs of Miagrammopes (Araneae: Araneaidae) in the neotropics. Psyche 85: 1-13.

Lucas S. (1988a): Spiders in Brasil. Toxicon 26: 759-766.

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Edmonds D.T. (1997): The contribution of atmospheric water vapour to the formation of a spider's capture web. In: Heimer S. (Ed.), Proceedings of the 17th European Colloquium of Arachnology. Oxford Press, London, pp. 35-46.

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Papers should be written with Word for Windows using "Times New Roman CE" size 12 font, align left and margins of 3 cm on A4 pages. Double spacing should be used between lines and paragraphs should be separated with a single empty line. The title and chapters should be written bold in font size 14. The latin names of all genera and species must be written italic. All submissions should be sent to the editor in the appropriate electronic version on diskette, CD or via e-mail in Rich text format (.rtf) or Word document (.doc) format.

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Papers should not exceed a total of ten illustrations and/or tables, with their positon amongst the text clearly indicated by the author(s). Tables with their legends should be submitted on separate pages. Titles of tables should appear above them, and titles of illustrations and photographs below. Illustrations and tables should be cited shortly in the text (Tab. 1 or Tabs. 1-2, Fig. 1 or Figs. 1-2).

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References should be cited in the text as follows: a single author is cited, as Schultz (1987) or (Schultz 1987); two authors would be (Parry & Brown 1959); if a work of three or more authors is cited, (Lubin et al. 1978); and if the reference appears in several works, (Ward 1991, Pace 1992, Amman 1998). If several works by the same author published in the same year are cited, the individual works are indicated with the added letters a, b, c, etc. (Lucas 1988a, b). The literature should be arranged in alphabetical order.

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Lubin Y.D., Eberhard W.G., Montgomery G.G. (1978): Webs of Miagrammopes (Araneae: Araneaidae) in the neotropics. Psyche 85: 1-13.
Lucas S. (1988a): Spiders in Brasil. Toxicon 26: 759-766.
Lucas S. (1988b): Spiders and their silks. Discovery 25: 1-4.

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Foelix R.F. (1996): Biology of spiders, 2. edition. Harvard University Press, London, pp. 155-162.
Nentwig W., Heimer S. (1987): Ecological aspects of spider webs. In: Nentwig W. (Ed.), Ecophysiology of Spiders. Springer Verlag, Berlin, 211 pp.
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