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Tipologija jezer v Sloveniji

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Izvleček. V skladu z Vodno direktivo smo pripravili tipologijo naravnih jezer v Sloveniji s površino >50 ha. Takšni sta Blejsko in Bohinjsko jezero. Preverili smo oba predlagana sistema za pripravo tipologije po Vodni direktivi (Direktiva 2000/60/ES) in ugotovili, da po sistemu A ne dosežemo dovolj dobre diferenciacije za opis bioloških referenčnih razmer. Izbrali smo sistem B in obveznim deskriptorjem – geografskemu položaju oz. ekoregijam, velikosti površine jezera, povprečni globini jezera, geološki podlagi in nadmorski višini – dodali še izbirni deskriptor. Deskriptor, ki smo ga izbrali, je pripadnost bioregiji (*sensu* Urbanič 2006a), ki vključuje tudi dva obvezna deskriptorja – geološko podlago in nadmorsko višino, zato ju posebej pri opisu tipov nismo navajali.

Ključne besede: tipologija, jezera, biološki elementi, Vodna direktiva, Slovenija

Abstract. TYPOLOGY OF LAKES IN SLOVENIA - A typology of natural lakes in Slovenia with the surface area of >50 ha was prepared according to the Water Framework Directive. Lake Bled and Lake Bohinj were taken into consideration only. Both systems proposed by the Water Framework Directive (Directive 2000/60/EC) for the preparation of the lake typology were tested. Using the system A, the satisfactory differentiation for the description of biological reference conditions could not be established. The system B was chosen based on the obligatory descriptors that include altitude, latitude, longitude, depth, geology and size. An additional descriptor, which concerns bioregional affiliation, was also chosen (*sensu* Urbanič, 2006a), which includes two obligatory descriptors, altitude and geology. These two descriptors are not specifically mentioned in the description of lake types.

Key words: typology, lakes, biological elements, Water Framework Directive, Slovenia

Uvod

Razvrstitev voda po ekoloških značilnostih oz. tipizacija voda je eden ključnih korakov pri implementaciji Vodne direktive (Direktiva 2000/60/ES, Priloga II). Za opis tipov voda sta v Vodni direktivi predlagana dva sistema. V sistemu A so deskriptorji za opis tipov že določeni, tako kot so tudi že določene kategorije vrednosti posameznih deskriptorjev. V sistemu B pa so poleg obveznih deskriptorjev, ki so enaki kot v sistemu A, vendar nimajo določenih kategorij, navedeni še izbirni deskriptorji. Za opis tipov jezer so obvezni deskriptorji ekoregije oz. zemljepisna dolžina in širina, nadmorska višina, povprečna globina vode, velikost površine jezera in geološka podlaga (pregl. 1).

Preglednica 1: Opisni deskriptorji in kategorije deskriptorjev za opis tipov jezer na podlagi sistema A (Direktiva 2000/60/ES).

Deskriptorji	Kategorije
Ekoregije	25 ekoregij, prikazanih na karti A v prilogi XI Direktive 2000/60/ES
Nadmorska višina	gorska: > 800 m
	srednjegorska: 200 do 800 m
	nižinska: < 200 m
Povprečna globina	<3 m
	3 m do 15 m
	>15 m
Velikost površine	0,5-1 km^2
	1-10 km^2
	10 do 100 km^2
	> 100 km^2
Geološka podlaga	karbonatna
	silikatna
	organska

Za vrednotenje ekološkega stanja je izbran t.i. pristop tipsko značilnih referenčnih razmer (Direktiva 2000/60/EC). Tipologija mora biti pripravljena tako, da ima vsak opisani tip drugačne biološke referenčne razmere. Preverjanje ustreznosti tipologije navadno opravimo z biološkimi podatki, ki so bili pridobljeni z referenčnih mest (Wallin in sod. 2003). V primerih, ko zaradi pomanjkanja referenčnih mest ali zgodovinskih podatkov z referenčnih mest podatki niso na voljo, so številni avtorji (npr. Ferréol et al. 2005, Verdonschot in Nijboer 2004) uporabili tudi podatke z vzorčnih mest, ki dosegajo vsaj dobro ekološko stanje.

V Sloveniji imamo v kategoriji jezera le dve naravni jezeri s površino, večjo od 50 ha oz. 0,5 km^2 (pregl. 2), to sta Blejsko in Bohinjsko jezero. Presihajoče Cerkniško jezero so vodotoki, ki poplavljajo Cerkniško polje. Vodotoki Cerkniškega polja s prispevno površino, večjo od 10 km^2, so uvrščeni v kategorijo reke (Urbanič 2005b) različnih tipov (Urbanič 2006b).

Preglednica 2: Opisni deskriptorji in tip jezer v Sloveniji na podlagi sistema A Vodne direktive (Direktiva 2000/60/ES)

Ime jezera	**Hidroekoregija** (Urbanič 2005a)	**Nadmorska višina**	**Povprečna globina**	**Geološka podlaga**	**Velikost površine**	**Povprečna globina**	**Tip**
Bohinjsko jezero	4	200-800	> 15 m	karbonatna	1-10 km^2	> 15 m	AL1
Blejsko jezero	4	200-800	> 15 m	karbonatna	1-10 km^2	> 15 m	AL1

Cilj predstavljenega dela je opis tipov jezer v Sloveniji v skladu z Vodno direktivo (Direktiva 2000/60/EC) in preveritev ustreznosti tipologije z biološkimi elementi. Predstavljena tipologija bo omogočila, da bomo s kombinacijo izbranih deskriptorjev v prihodnje lahko zanesljivo določili tipsko specifične referenčne biološke razmere, ki bodo izhodišče za vrednotenje ekološkega stanja omenjenih dveh jezer v Sloveniji.

Metode in materiali

Določitev tipov jezer smo opravili v treh korakih. V prvem koraku smo obe jezeri uvrstili v ustrezen tip glede na deskriptorje in kategorije deskriptorjev, predlagane v sistemu A. V drugem koraku smo ustreznost uporabljene tipologije preverili z biološkimi podatki. Napravili smo analize podobnosti in narisali drevesa podobnosti za vse biološke elemente, ki so v Vodni direktivi (Direktiva 2000/60/ES) predlagani za vrednotenje ekološkega stanja jezer. Napravili smo analize s podatki fitoplanktona, fitobentosa, makrofitov, bentoških nevretenčarjev in rib. Za izračun podobnosti jezer na podlagi rib smo uporabili podatke o vrstni sestavi, ki je vključevala le vrste, ki v jezero niso bile vložene. Referenčne vrste rib za obe jezeri smo določili tudi s pomočjo historičnih podatkov (Franke 1892). Za izračun podobnosti smo uporabili Sörensenov indeks. Za vse druge skupine organizmov smo podobnost med združbami jezer izračunali z Bray-Curtisovim indeksom podobnosti. Uporabili smo le podatke, pridobljene

med letoma 2000 in 2006, ko je bilo trofično stanje obeh jezer oligotrofno oz. oligo-mezotrofno (pregl. 3). Za izračun podobnosti smo uporabili kvantitativne podatke. Za izris dreves podobnosti smo uporabili metodo netehtanega skupinskega povprečja. V tretjem koraku smo pripravili dokončno tipizacijo jezer po sistemu B, in sicer tako, da smo deskriptorjem sistema A dodali še izbrane deskriptorje.

Preglednica 3: Trofično stanje Blejskega in Bohinjskega jezera na podlagi kriterijev OECD - povprečne letne vsebnosti skupnega fosforja, anorganskega dušika in klorofila *a*, ter povprečne in minimalne prosojnosti v letih 2000-2005.

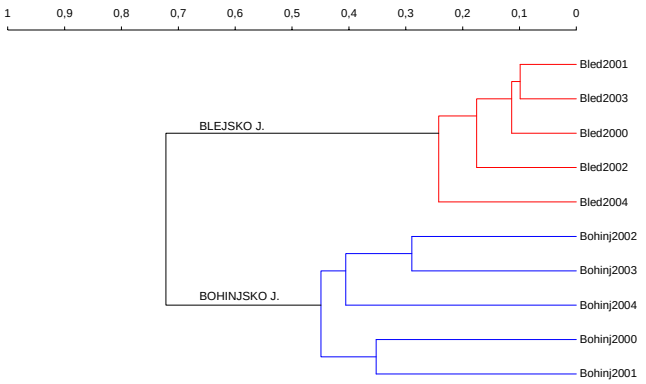
Parameter	**povprečna vsebnost fosforja**	**povprečna vsebnost anorg. dušika**	**povprečna prosojnost**	**minimalna prosojnost**	**klorofil a povp.**	**klorofil a maks.**
Trofičnost	[µg P/l]	[µg N/l]	[m]	[m]	[µg/l]	[µg/l)
u-oligotrofno	**< 4**	**< 200**	**> 12**	**> 6**	**< 1**	**< 2,5**
oligotrofno	**< 10**	**200 - 400**	**> 6**	**> 3**	**< 2,5**	**< 8**
mezotrofno	**10 - 35**	**300 - 650**	**6 - 3**	**3 - 1,5**	**2,5 - 8**	**8 - 25**
evtrofno	**35 - 100**	**500 - 1500**	**3 - 1,5**	**1,5 - 0,7**	**8 - 25**	**25 -75**
hiperevtrofno	**> 100**	**> 1500**	**< 1,5**	**< 0,7**	**> 25**	**> 75**
Blejsko jezero						
2000	14,3	280	5,3	2,0	7,2	25,7
2001	14,3	263	6,5	2,6	7,2	24,5
2002	12,6	247	7,9	5,0	4,7	19,3
2003	12,7	252	6,7	3,5	6,2	23,4
2004	13,0	273	5,9	2,7	5,6	22,3
2005	11,7	296	7,2	4,5	3,5	12,3
Bohinjsko jezero						
2000	3,3	468	9,1	4,9	1,6	3,1
2001	4,9	380	10,4	7,3	1,4	2,8
2002	3,5	450	9,8	6,4	1,4	3,3
2003	4,0	423	9,6	7,0	1,3	4,5
2004	4,7	469	8,7	4,5	1,2	3,2
2005	5,1	446	9,7	5,9	1,0	4,1

Rezultati

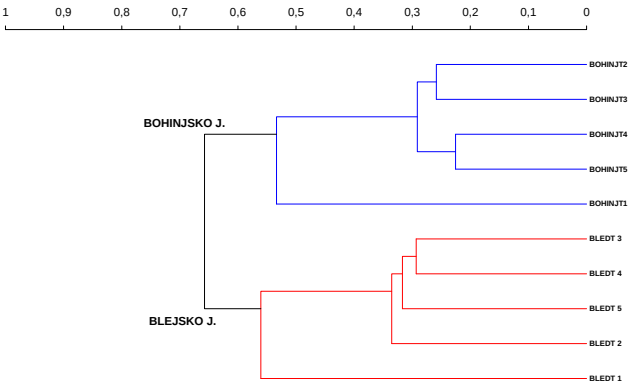
S tipizacijo po sistemu A smo obe jezeri uvrstili v isti tip (pregl. 2). Tako Bohinjsko kot Blejsko jezero sta globoki jezeri (>15 m) na nadmorski višini med 200 in 800 m s površino med 1 in 10 km^2 in s karbonatno podlago.

Z analizami podobnosti na podlagi različnih združb organizmov smo ugotovili, da sta jezeri v povprečju različni. Variabilnost vzorcev fitoplanktona enega jezera je bila manjša kot variabilnost med jezeroma. Povprečna različnost med jezeroma je več kot 0,7 (sl. 1). Podobne

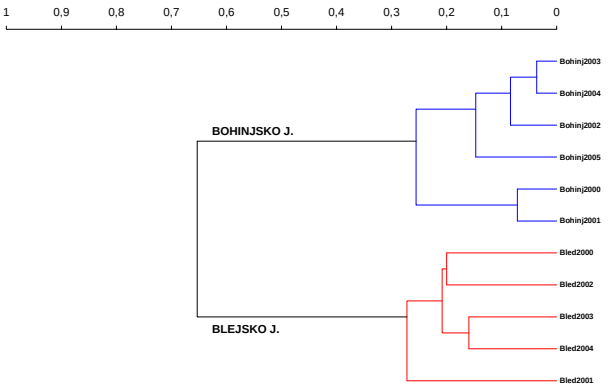
rezultate smo dobili tudi na podlagi združb fitobentosa, kjer je povprečna različnost nekoliko manjša (sl. 2) in je podobna povprečni različnosti, kot smo jo ugotovili na podlagi makrofitov (sl. 3). V obeh primerih znaša nekoliko manj kot 0,7. Najvišjo povprečno različnost med jezeroma smo ugotovili na podlagi podatkov o bentoških nevretenčarjih (sl. 4). Vrednost je presegala 0,7, vendar je bila tudi različnost med vzorci posameznega jezera v nekaterih primerih dokaj visoka. Vzrok dokaj visoke različnosti med vzorci bentoških nevretenčarjev, nabranih v istem jezeru, je v stopnji taksonomske determinacije, ki je bila pri nekaterih skupinah le stopnja poddružine (nekateri dvokrilci in maloščetinci) in v vzorčenju na različnih podlagah. Dokaj visoko različnost med jezeroma smo ugotovili tudi na podlagi primerjave združb rib, saj imata obe jezeri le nekaj več kot 50% istih avtohtonih ribjih vrst (sl. 5).



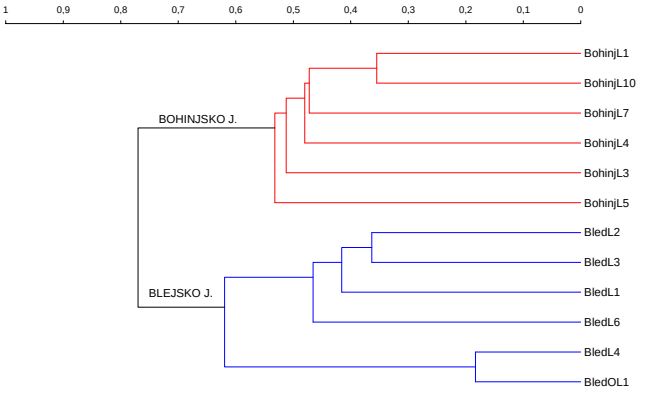
Slika 1: Drevo podobnosti na podlagi fitoplanktona iz Blejskega in Bohinjskega jezera.



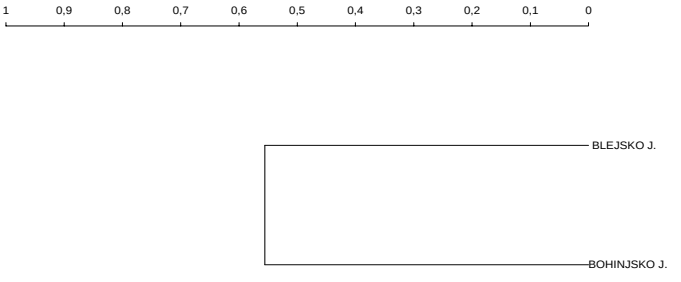
Slika 2: Drevo podobnosti na podlagi fitobentosa iz Blejskega in Bohinjskega jezera.



Slika 3: Drevo podobnosti na podlagi makrofitov iz Blejskega in Bohinjskega jezera.



Slika 4: Drevo podobnosti na podlagi bentoških nevretenčarjev iz Blejskega in Bohinjskega jezera.



Slika 5: Drevo podobnosti na podlagi rib iz Blejskega in Bohinjskega jezera.

Na podlagi ugotovljenih razlik med združbami organizmov obeh jezer smo ugotovili, da tipizacija po sistemu A ne zadošča za razlikovanje obeh naravnih jezer. Za opis tipov jezer smo poleg obveznih deskriptorjev sistema A (pregl. 1) izbrali še izbirne deskriptorje. Izbrani izbirni deskriptor je pripadnost bioregiji (sensu Urbanič 2006a). Ker sta nadmorska višina in geološka podlaga upoštevani že pri določitvi bioregij (Urbanič 2006a), jih pri opisu tipov nismo ponovno navajali (pregl. 4).

Preglednica 4: Tipi jezer v Sloveniji po sistemu B Vodne direktive (Direktiva 2000/60/ES), z dodanimi izbirnimi deskriptorji.

Ime jezera	**Hidroekoregija** (Urbanič 2005a)	**Bioregija** (Urbanič 2006a)	**Povp. globina**	**Velikost površine**	**Tip**	**Tip-koda**
Bohinjsko jezero	Alpe	Karbonatne Alpe donavskega porečja	> 15 m	1-10 km^2	Globoka alpska jezera	J_SI_4_KB-D_>15_1-10
Blejsko jezero	Alpe	Predalpska hribovja donavskega porečja	> 15 m	1-10 km^2	Globoka predalpska jezera	J_SI_4_ PA-D _>15_1-10

Razprava

Z analizami podobnosti združb organizmov Blejskega in Bohinjskega jezera smo ugotovili, da je tipizacija jezer v Sloveniji po sistemu A (*sensu* Direktiva 2000/60/EC) neprimerna za dosego dovolj dobrega ločevanja za opis tipsko specifičnih bioloških referenčnih razmer. Z vsemi biološkimi elementi smo ugotovili, da se jezeri na podlagi združbe organizmov razlikujeta. Nasprotno sta obe jezeri za primerjalno vrednotenje metodologij vrednotenja ekološkega stanja na podlagi fitoplanktona in makrofitov z drugimi državami območja Alp uvrščeni v isti interkalibracijski tip t.i. globokih alpskih jezer z oznako L-AL3 (Evropska komisija 2005). Glede na dejstvo, da imata obe jezeri verjetno isto referenčno (naravno) trofično stanje, bi na podlagi vsaj fitoplanktona lahko ugotovili večjo podobnost med jezeroma in ju tako morda uvrstili v isti tip. Tudi bentoški nevretenčarji se odzivajo na trofične spremembe v jezerih (Czachorowski 1993), kar bi lahko pomenilo, da je nizka podobnost med obema jezeroma rezultat antropogene povzročitve razlik v produktivnosti jezera. Ne glede na to smo s primerjavo referenčnih združb rib obeh jezer ugotovili, da moramo jezeri uvrstiti v dva različna tipa, saj je podobnost med jezeroma dokaj nizka. V vsakem primeru je ena izmed osnovnih razlik med jezeroma v samem geografskem položaju jezer, saj Bohinjsko jezero leži v alpskem vplivnem območju, Blejsko jezero pa v predalpskem. Z upoštevanjem bioregij (*sensu* Urbanič

2006a) kot deskriptorja za opis tipov smo razliko v ekoloških značilnostih vplivnega območja tudi upoštevali. Potrditev razlike v vplivnem območju se kaže tudi v povprečni letni temperaturi vode jezera, ki je bila v obdobju 1998-2003 v Bohinjskem jezeru z 10,5 °C za več kot 3 °C nižja kot v Blejskem jezeru (13,8 °C). Temperatura vode pa je eden ključnih dejavnikov, ki vplivajo na vodne organizme (e.g. Wiederholm 1971). Le ta pa gotovo vpliva tudi na referenčne razmere.

Summary

With intention to determine the type specific reference biological conditions for natural lakes in Slovenia, Lake Bled and Lake Bohinj were tested according to the A and B systems of the Water Framework Directive (Directive 2000/60/EC). The result of determination, using system A, showed that both lakes fall into the same type. The suitability of type determination of both lakes with system A was checked by using biological data. Analyses of similarity of different biological elements (phytoplankton, phytobenthos, macrophytes, benthic invertebrates and fish fauna) indicate that the lakes differ between each other. The greatest dissimilarity was found in their benthic invertebrate communities (0.78), followed by phytoplankton (0.72), phytobenthos and macrophytes (0.7) and fish fauna (0.5). However, especially in cases of water plants and benthic invertebrates, the observed differences were also due to the differences in trophic states of the lakes. On the other hand, reference fish communities were used for comparison, by which substantial differences between the two lakes were confirmed. Having in mind the mentioned differences in the lakes' communities, the differentiation of lakes due to system A do not draw a distinction between the two lakes. To the obligatory descriptors of the system A, the optional Bioregion descriptor was added. Due to this additional descriptor (*sensu* Urbanič 2006a), Lake Bohinj is classified as a Deep Alpine lake and Lake Bled as a Deep pre-Alpine lake. Apart from differences in biological communities, the lakes differ in their geographical position, reflected in mean annual temperature of the water (10.5 °C for Lake Bohinj and 13.8 °C for Lake Bled). The difference of annual temperature affects water communities and consequently reference conditions.

Zahvala

Zahvaljujemo se recenzentu za njegove komentarje na prejšnjo verzijo besedila.

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Checklist of the ants of Slovenia (Hymenoptera: Formicidae)

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Abstract. A checklist of the ants of Slovenia with 132 species is presented. Sixteen species are new for the Slovenian ant fauna (*Ponera testacea*, *Cardiocondyla elegans*, *Myrmica gallienii*, *Myrmica lobulicornis*, *Myrmica rugulosa*, *Temnothorax italicus*, *Temnothorax lichtensteini*, *Temnothorax recedens*, *Temnothorax saxonicus*, *Tetramorium hungaricum*, *Tetramorium moravicum*, *Tetramorium semilaeve*, *Formica fuscocinerea*, *Lasius balcanicus*, *Plagiolepis ampeloni*, *Plagiolepis xene*). Distribution of the recorded species according to the phytogeographic regions of Slovenia is also indicated.

Keywords: ants, Formicidae, checklist, Slovenia

Izvleček. SEZNAM MRAVELJ SLOVENIJE (HYMENOPTERA: FORMICIDAE) - Predstavljen je seznam mravelj Slovenije s 132 vrstami. Šestnajst vrst je novih za slovensko favno mravelj (*Ponera testacea*, *Cardiocondyla elegans*, *Myrmica gallienii*, *Myrmica lobulicornis*, *Myrmica rugulosa*, *Temnothorax italicus*, *Temnothorax lichtensteini*, *Temnothorax recedens*, *Temnothorax saxonicus*, *Tetramorium hungaricum*, *Tetramorium moravicum*, *Tetramorium semilaeve*, *Formica fuscocinerea*, *Lasius balcanicus*, *Plagiolepis ampeloni*, *Plagiolepis xene*). Navedena je tudi razširjenost najdenih vrst glede na fitogeografska območja Slovenije.

Ključne besede: mravlje, Formicidae, seznam, Slovenija

Introduction

For a long time, the ants were a more or less neglected group of insects in Slovenia. The investigations of myrmecofauna were mostly restricted to smaller areas. Bračko (2000) was the first who presented a more general review of the Slovenian ant fauna. Nevertheless, the ants of some parts of the country, especially in the east, were still relatively poorly known. In the ensuing years, Slovenian territory was investigated more thoroughly and the ant list was supplemented by some additional species (Bračko 2003, Schlick-Steiner et al. 2003), so that 119 species were known for Slovenia.

In the last two decades, many ant taxonomic works with more sophisticated approach have been published. This resulted in many taxonomic changes and description of new species, especially within the genera *Myrmica*, *Leptothorax* (*Temnothorax*), *Formica*, *Lasius*. The *Synopsis and Classification of Formicidae* by Bolton (2003) also brings certain novelties in ant classification. For instance, most of the species that were formerly included in *Leptothorax sensu lato* are now placed in the genus *Temnothorax*.

This paper presents an updated checklist of the ants of Slovenia. Altogether, 132 species have been recorded. Sixteen species are new for the Slovenian ant fauna. Distribution of the recorded species is given according to the phytogeographic regions of Slovenia as defined by Wraber (1969) (AL – Alpine, PA – Prealpine, SM – Submediterranean, DN – Dinaric, PD – Predinaric, SP – Subpannonian).

The following taxonomic literature was used for the species identification: Kutter (1977), Agosti & Collingwood (1987), Seifert (1995, 1996, 2000, 2002, 2003, 2005, 2006), Csősz & Seifert (2003), Csősz & Markó (2004), Csősz et al. (2007). Ant classification and taxonomic nomenclature generally follow Bolton (1995, 2003).

List of ant species

Subfamily PONERINAE Lepeletier, 1835

Cryptopone ochracea (Mayr, 1855): SM
Ponera coarctata (Latreille, 1802): AL, PA, SM, DN, PD, SP
Ponera testacea Emery, 1895 [1]: PA, SM, PD

Subfamily PROCERATIINAE Emery, 1895

Proceratium melinum (Roger, 1860): SM

Subfamily MYRMICINAE Lepeletier, 1835

Aphaenogaster epirotes (Emery, 1895): SM
Aphaenogaster ionia Santschi, 1933 [2]: SM
Aphaenogaster muelleriana Wolf, 1915: SM
Aphaenogaster subterranea (Latreille, 1798): PA, SM, DN, PD, SP
Cardiocondyla elegans Emery, 1869 [1]: SM
Chalepoxenus muellerianus (Finzi, 1922): SM
Crematogaster schmidti (Mayr, 1853): SM
Crematogaster scutellaris (Olivier, 1792): SM
Crematogaster sordidula (Nylander, 1849): SM
Formicoxenus nitidulus (Nylander, 1846): AL, SM, PD, SP
Harpagoxenus sublaevis (Nylander, 1849): AL
Leptothorax acervorum (Fabricius, 1793): AL, PA, SM, DN, PD, SP
Leptothorax gredleri Mayr, 1855: PA, SP
Leptothorax muscorum (Nylander, 1846): AL, DN
Leptothorax pacis (Kutter, 1945): AL
Manica rubida (Latreille, 1802): AL, PA, SM, DN
Messor capitatus (Latreille, 1798): SM
Messor structor (Latreille, 1798): SM
Messor wasmanni Krausse, 1910: SM
Monomorium monomorium Bolton, 1987: SM
Monomorium pharaonis (Linnaeus, 1758) (non-indigenous species)
Myrmecina graminicola (Latreille, 1802): AL, PA, SM, DN, PD, SP

Myrmica gallienii Bondroit, 1920 [1]: SP
Myrmica lobicornis Nylander, 1846: AL, SM, DN, SP
Myrmica lobulicornis Nylander, 1857 [1]: AL
Myrmica lonae Finzi, 1926: AL
Myrmica rubra (Linnaeus, 1758): AL, PA, SM, DN, PD, SP
Myrmica ruginodis Nylander, 1846: AL, PA, SM, DN, PD, SP
Myrmica rugulosa Nylander, 1849 [1]: PD
Myrmica sabuleti Meinert, 1861: AL, PA, SM, DN, PD, SP
Myrmica salina Ruzsky, 1905: PA, PD, SP
Myrmica scabrinodis Nylander, 1846: AL, PA, SM, DN, PD, SP
Myrmica schencki Viereck, 1903: AL, PA, SM, DN, PD, SP
Myrmica specioides Bondroit, 1918: AL, PA, SM, DN, PD, SP
Myrmica sulcinodis Nylander, 1846: AL
Myrmica vandeli Bondroit, 1920: DN
Myrmoxenus kraussei (Emery, 1915): SM
Myrmoxenus ravouxi (André, 1896): SM
Pheidole pallidula (Nylander, 1849): SM
Solenopsis fugax (Latreille, 1798): PA, SM, DN, PD, SP
Solenopsis wolfi Emery, 1915: SP
Stenamma debile (Förster, 1850): AL, PA, SM, DN, PD, SP
Stenamma petiolatum Emery, 1897: PA, DN
Stenamma striatulum Emery, 1895: AL, PA, SM, DN, PD, SP
Strongylognathus alboini Finzi, 1924: DN
Strongylognathus testaceus (Schenck, 1852): SP
Temnothorax affinis (Mayr, 1855): AL, PA, SM, DN, PD, SP
Temnothorax clypeatus (Mayr, 1853): SM, SP
Temnothorax corticalis (Schenck, 1852): SP
Temnothorax crassispinus (Karavaiev, 1926): AL, PA, SM, DN, PD, SP
Temnothorax exilis (Emery, 1869): SM
Temnothorax flavicornis (Emery, 1870): SM
Temnothorax interruptus (Schenck, 1852): AL, PA, SM, DN, PD
Temnothorax italicus (Consani, 1952) [1]: SM
Temnothorax lichtensteini (Bondroit, 1918) [1]: SM
Temnothorax nigriceps (Mayr, 1855): AL, PA, SM, DN, PD, SP
Temnothorax parvulus (Schenck, 1852): PA, SM, PD, SP
Temnothorax recedens (Nylander, 1856) [1]: SM
Temnothorax saxonicus (Seifert, 1995) [1]: PA, SM

Temnothorax sordidulus (Müller, 1923): PA, SM, DN, PD
Temnothorax tuberum (Fabricius, 1775) [3]: AL, DN
Temnothorax unifasciatus (Latreille, 1798): AL, PA, SM, DN, SP
Tetramorium caespitum/ impurum complex [4]: AL, PA, SM, DN, PD, SP
Tetramorium hungaricum Röszler, 1935 [1]: PA
Tetramorium moravicum Kratochvil, 1941 [1]: SM
Tetramorium semilaeve André, 1883 [1]: SM

Subfamily DOLICHODERINAE Forel, 1878

Bothriomyrmex adriacus Santschi, 1922: SM, PD
Dolichoderus quadripunctatus (Linnaeus, 1771): AL, PA, SM, DN, PD, SP
Liometopum microcephalum (Panzer, 1798): SP
Tapinoma ambiguum Emery, 1925: AL, PA, SM, DN, PD, SP
Tapinoma erraticum (Latreille, 1798): AL, PA, SM, DN, PD, SP

Subfamily FORMICINAE Latreille, 1809

Camponotus aethiops (Latreille, 1798): PA, SM, PD, SP
Camponotus dalmaticus (Nylander, 1849): SM
Camponotus fallax (Nylander, 1856): PA, SM, DN, SP
Camponotus herculeanus (Linnaeus, 1758): AL, DN
Camponotus lateralis (Olivier, 1792): SM
Camponotus ligniperda (Latreille, 1802): AL, PA, SM, DN, PD, SP
Camponotus piceus (Leach, 1825): PA, SM, DN, PD, SP
Camponotus tergestinus Müller, 1921: SM
Camponotus truncatus (Spinola, 1808): PA, SM, PD, SP
Camponotus vagus (Scopoli, 1763): AL, PA, SM, DN, PD, SP
Formica aquilonia Yarrow, 1955: AL, PA, DN
Formica cinerea Mayr, 1853 [5]: AL, PA, SM
Formica cunicularia Latreille, 1798: AL, PA, SM, DN, PD, SP
Formica exsecta Nylander, 1846: AL, SM
Formica fusca Linnaeus, 1758: AL, PA, SM, DN, PD, SP
Formica fuscocinerea Forel, 1874 [1]: AL, PA, SP
Formica gagates Latreille, 1798: PA, SM, DN, PD, SP
Formica lemani Bondroit, 1917: AL, DN
Formica lugubris Zetterstedt, 1838: AL, PA, DN

Formica lusatica Seifert, 1997: AL, PA, SM, PD, SP
Formica polyctena Förster, 1850: AL, PA, SM, DN, PD, SP
Formica pratensis Retzius, 1783: AL, PA, SM, DN, PD, SP
Formica pressilabris Nylander, 1846: AL, SM
Formica rufa Linnaeus, 1761: AL, PA, SM, DN, PD, SP
Formica rufibarbis Fabricius, 1793: AL, PA, SM, DN, PD, SP
Formica sanguinea Latreille, 1798: AL, PA, SM, DN, PD, SP
Formica selysi Bondroit, 1918: PA, DN
Formica truncorum Fabricius, 1804: AL, SM, DN
Lasius alienus (Förster, 1850): AL, PA, SM, DN, PD, SP
Lasius balcanicus Seifert, 1988 [1]: SM, PD
Lasius bicornis (Förster, 1850): SP
Lasius brunneus (Latreille, 1798): AL, PA, SM, DN, PD, SP
Lasius carniolicus Mayr, 1861: PA, SM
Lasius citrinus Emery, 1922: PA, DN
Lasius distinguendus (Emery, 1916): AL, PA, SM, DN, PD, SP
Lasius emarginatus (Olivier, 1792): AL, PA, SM, DN, PD, SP
Lasius flavus (Fabricius, 1781): AL, PA, SM, DN, PD, SP
Lasius fuliginosus (Latreille, 1798): AL, PA, SM, DN, PD, SP
Lasius jensi Seifert, 1982: DN
Lasius meridionalis Bondroit, 1920: SM, DN
Lasius mixtus (Nylander, 1846): PA, DN
Lasius myops Forel, 1894: PA, SM, DN, PD, SP
Lasius niger (Linnaeus, 1758): AL, PA, SM, DN, PD, SP
Lasius nitidigaster Seifert, 1997: SM, DN
Lasius paralienus Seifert, 1992: AL, PA, SM, DN, PD, SP
Lasius platythorax Seifert, 1991: AL, PA, SM, DN, PD, SP
Lasius psammophilus Seifert, 1992: AL, PA, SM, DN, PD, SP
Lasius reginae Faber, 1967: SM
Lasius sabularum (Bondroit, 1918): AL, PA, SM, DN, PD, SP
Lasius umbratus (Nylander, 1846): AL, PA, SM, DN, PD, SP
Plagiolepis ampeloni (Faber, 1969) [1]: SM
Plagiolepis pygmaea (Latreille, 1798): PA, SM, DN, PD, SP
Plagiolepis vindobonensis Lomnicki, 1925: AL, PA, SM
Plagiolepis xene Stärcke, 1936 [1]: SM
Polyergus rufescens (Latreille, 1798): AL, PA, SM, PD, SP
Prenolepis nitens (Mayr, 1853): PA, SM, DN, PD, SP

[1] New species for the ant fauna of Slovenia.

[2] Cobelli (1906) reported *Aphaenogaster testaceo-pilosa* (Lucas, 1849) from the vicinity of Piran. Müller (1923) placed this record under *A. testaceopilosa* var. *balcanica* (Emery, 1898) which was later raised to species. *A. balcanica* was also mentioned in the list of Slovenian ants in Bračko (2000). However, the right identity of this record should be *A. ionia*. Already Baroni Urbani (1971) placed Cobelli's data under *A. semipolita* ssp. *ionia* (= *A. ionia*). This species is quite common along the Adriatic coast, while *A. balcanica* has more southern Balkan distribution. Moreover, few workers of *A. ionia* were found in Piran in 2004, nearby the locality where Cobelli found »*Aphaenogaster testaceo-pilosa*«.

[3] Bračko (2003) gave records of *Leptothorax* (= *Temnothorax) albipennis* (Curtis, 1854). That material was re-checked and identified as *T. tuberum* (det. A. Schulz, G. Bračko).

[4] A multidisciplinary approach utilizing molecular genetic methods and morphological analyses, and incorporating cuticular hydrocarbons data revealed the existence of seven very similar species from the *Tetramorium caespitum*|*impurum* complex, i.e. *T. caespitum* (L.), *T. impurum* (Förster, 1850) and five other yet undescribed species (Schlick-Steiner et al. 2006). The samples from Slovenia that were included in this study were classified into two species with code names B and E. Steiner et al. (2006) also presented a morphology-based identification engine for ants of the *Tetramorium caespitum*|*impurum* complex which requires 21 characters, captured with high-precision morphometry. In the present paper, all the material determined as *T. caespitum* or *T. impurum* according to previous taxonomic keys, and older literature data for the two mentioned species, are designated as *Tetramorium caespitum*|*impurum* complex in the list of species. The available material was not identified further.

[5] Two species that were listed in Bračko (2000), i.e. *F. balcanina* Petrov & Collingwood, 1993 and *F. imitans* Ruzsky, 1902, were synonymized with *F. cinerea* (Seifert 2002). The re-checking of two samples of »*F. imitans*« from Ptuj and Gornja Radgona showed that they actually belong to *F. fuscocinerea*, a sibling species of *F. cinerea*.

Povzetek

Mravlje so bile v Sloveniji dolgo precej zapostavljena skupina žuželk. Bračko (2000) je predstavil prvi splošnejši pregled slovenske favne mravelj. S kasnejšimi raziskavami so bile najdene še dodatne vrste, tako da je bilo skupaj znanih 119 vrst mravelj (Bračko 2003, Schlick-Steiner et al. 2003).

V zadnjem času je bilo objavljenih več taksonomskih del, ki so prinesla veliko sprememb v taksonomiji določenih skupin mravelj in opise novih vrst, predvsem pri rodovih *Myrmica*, *Leptothorax* (*Temnothorax*), *Formica*, *Lasius*. Tudi pri določanju vrst za potrebe te raziskave je bila večinoma uporabljena novejša taksonomska literatura.

V prispevku je podan trenutni seznam mravelj Slovenije. Skupaj je bilo najdenih 132 vrst, od teh pa jih je 16 prvič omenjenih za Slovenijo (*Ponera testacea*, *Cardiocondyla elegans*, *Myrmica gallienii*, *M. lobulicornis*, *M. rugulosa*, *Temnothorax italicus*, *T. lichtensteini*, *T. recedens*, *T. saxonicus*, *Tetramorium hungaricum*, *T. moravicum*, *T. semilaeve*, *Formica fuscocinerea*, *Lasius balcanicus*, *Plagiolepis ampeloni*, *P. xene*). Podatek za vrsto *Aphaenogaster balcanica*, ki je bila navedena v seznamu v Bračko (2000), se nanaša na *A. ionia*. Ta vrsta je bila tudi ponovno najdena v Piranu leta 2004. S prejšnjih seznamov je prav tako treba izbrisati vrste *Leptothorax* (*Temnothorax*) *albipennis* (podatki se nanašajo na *T. tuberum*), *Formica balcanina* in *Formica imitans* (podatki se nanašajo na *F. cinerea* oziroma *F. fuscocinerea*). Material, ki je bil doslej določen in objavljen kot *Tetramorium caespitum* ali *T. impurum*, je tu definiran kot kompleks *Tetramorium caespitum/impurum*.

V seznamu vrst je navedena tudi njihova razširjenost na ozemlju Slovenije, in sicer na osnovi njihovega pojavljanja v posameznih fitogeografskih območjih (AL – alpsko, PA – predalpsko, SM – submediteransko, DN – dinarsko, PD – preddinarsko, SP – subpanonsko fitogeografsko območje).

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Topographical and vegetational characteristics of lynx kill sites in Slovenian Dinaric Mountains

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Abstract. We report on topographical and vegetational characteristics of 13 sites where Eurasian lynx (*Lynx lynx*) killed its prey in the Dinaric mountain range in Slovenia. The results suggest that lynx does not necessarily need dense vegetation and rugged terrain to successfully hunt its prey, however, it may influence its hunting success. A large part of the successful hunts took place on steep slopes and rugged terrain. 39% of kill sites were located in dolines, implying the potential importance of these karst structures for the hunting of large carnivores on ungulates in karst areas such as Dinaric Mountains.

Keywords: Eurasian lynx, *Lynx lynx*, predation, kill sites, Dinaric Mts, Slovenia

Izvleček. TOPOGRAFSKE IN VEGETACIJSKE ZNAČILNOSTI MEST, KJER SO RISI UPLENILI SVOJ PLEN V DINARIDIH V SLOVENIJI - Preučili smo topografske in vegetacijske značilnosti na 13 lokalitetah, kjer so evrazijski risi (*Lynx lynx*) uplenili svoj plen na območju Dinaridov v Sloveniji. Rezultati so pokazali, da lahko risi uplenijo svoj plen tudi na mestih brez goste vegetacije in razgibanega terena, vendar pa večja možnost kritja verjetno lahko vpliva na njegov lovni uspeh. Velik del uspešnih poskusov lova je potekal na strmih pobočjih in na razgibanem terenu. 39 % mest uplenitev je bilo ugotovljenih v vrtačah, kar kaže na potencialni pomen le-teh pri lovu velikih zveri na parkljarje na kraških območjih, kot so Dinaridi.

Ključne besede: evrazijski ris, *Lynx lynx*, predacija, mesta uplenitev, Dinaridi, Slovenija

Introduction

There are many factors that have been reported to affect the hunting behaviour and hunting success in carnivores (Sunquist & Sunquist 1989, Funston et al. 2001, Sand et al. 2006). Among them are also features of the habitat, where the hunt is taking place. Husseman et al. (2003) noted that micro location characteristics are more important for the stalking predators, such as felids, than for coursing predators, such as canids, for which the hunt usually takes place on much larger scale and the kill site is less habitat-specific.

When approaching their prey before the attack, all felids rely extensively on physical features in the environment that provide them with cover (Sunquist & Sunquist 1989). Since the presence of stalking cover influences the distance traversed in the final charge, it may have important effect on the hunting success.

Eurasian lynx (*Lynx lynx*), along with grey wolf (*Canis lupus*), is the main predator of ungulates in the Dinaric Mountains in Slovenia. Lynx hunts alone and usually stalks its prey or attacks it from ambush; surprise is therefore an important factor for hunting success (Kos et al. 2005). To be successful, lynx must get within a few meters of prey animal and it rarely chases its prey more than 100 meters (Krofel 2006).

Within the ongoing study on lynx ecology in Slovenian Dinaric Mountains, we are also studying the characteristics of kill sites that might be important for the hunting success of the lynx. Here, some of the preliminary results of this study are presented.

Study area

The study was conducted in the north-western part of Dinaric mountain range. Dinaric mountains extend along the Adriatic coast from the Friuli plain in Italy in the north-west to the Albanian mountains in the south-east. Study area (46°10'-45°25'N and 13°33'-15°13'E) is located in the High Karst region of Slovenia, covering 3287 km^2 (Kladnik 1998). Altitude ranges from approximately 168 m to the peak of Mount Snežnik at 1796 m, with average of 762 m and average inclination of 11° (source: DMV 12,5; Geodetska uprava RS). Limestones and dolomites are prevalent in the area, and the relief shows typical karst phenomena, such

as dolines, collapse dolines, uvalas, horizontal caves, vertical shafts, steep canyons, poljes, etc. Surface water is rare as water runoff is largely underground. The climate is a mix of influences from the Alps, the Mediterranean sea and the Pannonian basin with annual temperature averaging 5-8 °C, ranging from average maximum of 32 °C to a minimum of -20 °C, and average annual precipitation of 1400-3500 mm. The forest coverage of the High Karts region is 79%. Most of the area is covered by fir-beech association (Abieti-Fagetum dinaricum), with four dominant tree species: common beech (*Fagus sylvatica*), silver fir (*Abies alba*), Norway spruce (*Picea abies*), and sycamore maple (*Acer pseudoplatanus*) (Kordiš 1993). Population density in the High Karst region averages 28 inhabitants / km^2 (Kladnik 1998).

In Dinaric forests of Slovenia, lynx hunts mainly roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*), fat dormouse (*Glis glis*) and, to a lesser extent, other rodents, chamois (*Rupicapra rupicapra*), red fox (*Vulpes vulpes*), and birds (Krofel 2006). Two other species of large carnivores are also present in the area, i.e. brown bear (*Ursus arctos*) and grey wolf.

Methods

Lynx kill sites have been inspected between 2002 and 2006. We searched for lynx prey remains while snow tracking. In addition, we monitored the movement of one radio-marked female and searched for prey remains, if the lynx returned to the same location on consecutive days (Krofel et al. 2006). We also inspected dead animals found by chance during our field work and those found by local hunters and foresters.

We registered the vegetation and terrain characteristics in the radius of approximately 30 m around each kill site. We defined 4 categories for the tree density around the kill site: clearing (no trees or the average estimated distance between trees greater than 20 m), sparse (average estimated distance between trees 5 – 20 m), moderate (average estimated distance between trees 2 – 5 m), and dense tree density (average estimated distance between trees shorter than 2 m). Forest stands were categorized as deciduous, coniferous or mixed. We also noted the presence of deadwood on the ground and estimated the coverage of the understory higher than 30 cm, which we defined as: absent (no understory), sparse (less than 10% cover), moderate (10 – 50% cover), and abundant (more than 50% cover). We also subjectively estimated the ruggedness of the terrain: unrugged (relief more or less flat),

moderately rugged (some vertical rocky structures and minor undulation of the terrain, sometimes with few shallow dolines), and very rugged terrain (many vertical rocky structures and/or undulated terrain with many dolines and rocky cliffs). The inclination of the ground was pooled in three categories: less than 10 °, 10 ° - 45 °, and more than 45 °. In order to make results more comparable, all estimations were made by the same person (M.K.). Due to unsystematic manner of data collection before 2003, not all parameters were available for every site.

Results

In total, 13 lynx kill sites have been inspected (Tab. 1). At 11 sites, we found remains of a roe deer and at two a carcass of a red deer. Most of the inspected kill sites (54%) were located on the Menišija and Logatec plateau in the north-central part of the study area. Kill sites were found at the altitudes between 269 and 1060 m (mean 600 m). Locations of inspected kill sites are presented in Figure 1.

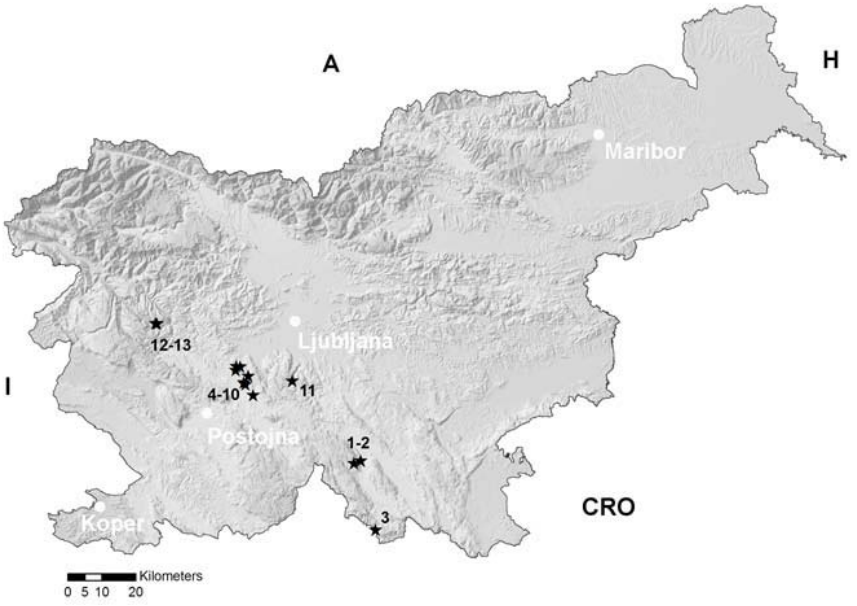

Figure 1: Locations of inspected lynx kill sites (n = 13). Numbers correspond to those in Tab. 1.
Slika 1: Lokacije najdenih ostankov risovega plena (n = 13). Številke lokacij ustrezajo tistim v tab. 1.

Table 1: List of inspected lynx kill sites and their characteristics.
Tabela 1: Seznam pregledanih mest, kjer so risi uplenili svoj plen, z njihovimi značilnostmi.

No./ Št.	Location/ Lokacija	Date/ Datum	Prey / Plen			Altitude/ Višina	Relief/ Relief	Inclination / Naklon	In a doline/V vrtači	Forest stand/ Gozdni sestoj	Tree density/ Gostota dreves	Understory/ Podrast	Deadwood/ Vejevje	Snow-cover/ Snežna odeja
			Starost/ Age	Sex/ Spol	Species / Vrsta									
1	Črni vrh, Velika gora	10.12. 2002	6 months/ 6 mesecev	F	*Cervus elaphus*	1060 m	very rugged/ zelo razgiban	-	no / ne	mixed/ mešani	moderate/ zmerna	-	-	present/ prisotna
2	Jelendol, Velika gora	27.3. 2003	3-4 years/ 3-4 leta	F	*Cervus elaphus*	650 m	unrugged/ nerazgiban	<10°	no / ne	mixed/ mešani	sparse/ redka	-	present/ prisotno	
3	Srebotnik, Kolpa	14.3. 2006	> 7 years/ > 7 let	F	*Capreolus capreolus*	269 m	moderately rugged / srednje razgiban	>45°	no / ne	deciduous/ listnat	sparse/ redka	sparse/ redka	present/ prisotna	absent/ brez
4	Pranger, Logaška planota	1.3. 2003	adult/ odrasel	M	*Capreolus capreolus*	572 m	very rugged/ zelo razgiban	-	yes / da	mixed/ mešani	moderate/ zmerna	sparse/ redka	absent/ brez	present/ prisotna
5	Pranger, Logaška planota	21.3. 2004	2-3 years/ 2-3 leta	M	*Capreolus capreolus*	527 m	moderately rugged / srednje razgiban	10-45°	yes / da	mixed/ mešani	moderate/ zmerna	absent/ brez	present/ prisotna	present/ prisotna
6	Drnulca, Menišija	1.2. 2005	> 7 years/ > 7 let	M	*Capreolus capreolus*	519 m	unrugged/ nerazgiban	<10°	no / ne	mixed/ mešani	sparse/ redka	sparse/ redka	present/ prisotna	5 cm
7	Bukov vrh, Menišija	2.3. 2005	9 month/ 9 mesecev	F	*Capreolus capreolus*	627 m	moderately rugged / srednje razgiban	<10°	no / ne	coniferous/ iglast	moderate/ zmerna	moderate/ zmerna	present/ prisotna	present/ prisotna
8	Bodič, Menišija	5.3. 2005	2-3 years/ 2-3 leta	F	*Capreolus capreolus*	516 m	very rugged/ zelo razgiban	10-45°	yes / da	mixed/ mešani	moderate/ zmerna	moderate/ zmerna	absent/ brez	40 cm
9	Ržišče, Menišija	17.3. 2005	4-6 years/ 4-6 let	F	*Capreolus capreolus*	603 m	very rugged/ zelo razgiban	<10°	no / ne	mixed/ mešani	moderate/ zmerna	moderate/ zmerna	present/ prisotna	absent/ brez
10	Dolgi tali, Menišija	25.5. 2005	4-6 years/ 4-6 let	F	*Capreolus capreolus*	708 m	moderately rugged / srednje razgiban	-	yes / da	mixed/ mešani	sparse/ redka	moderate/ zmerna	absent/ brez	absent/ brez
11	Trenk, Krimsko hribovje	16.3. 2006	> 7 years/ > 7 let	M	*Capreolus capreolus*	686 m	moderately rugged / srednje razgiban	10-45°	yes / da	mixed/ mešani	sparse/ redka	moderate/ zmerna	absent/ brez	30 cm
12	Sr. Kanomlja, Idrijsko hribovje	20.1. 2006	adult/ odrasel	-	*Capreolus capreolus*	707 m	unrugged/ nerazgiban	>45°	no/ne	mixed/ mešani	sparse/ redka	absent/ brez	absent/ brez	present/ prisotna
13	Sr. Kanomlja, Idrijsko hribovje	23.1. 2006	1,5 years/ 1,5 leta	M	*Capreolus capreolus*	651 m	moderately rugged / srednje razgiban	>45°	no/ne	mixed/ mešani	dense/ gosta	moderate/ zmerna	absent/ brez	50 cm

We estimated the tree density and understory cover in 13 and 11 cases, respectively. Usually, the lynx killed its prey in the forest of sparse or moderate tree density (46% instances each). In only one case (8%) the kill took place in a dense forest and never on a clearing (Fig. 2). The majority (85%) of prey remains were found in mixed forest stands, one in deciduous and one in coniferous forest stand. 55% of kill sites had moderate understory cover, followed by sparse (27%) and absent (18%) understory cover (Fig. 3). No prey remains were found at places with abundant understory cover. Deadwood was present on the ground on 50% of the sites (n = 12).

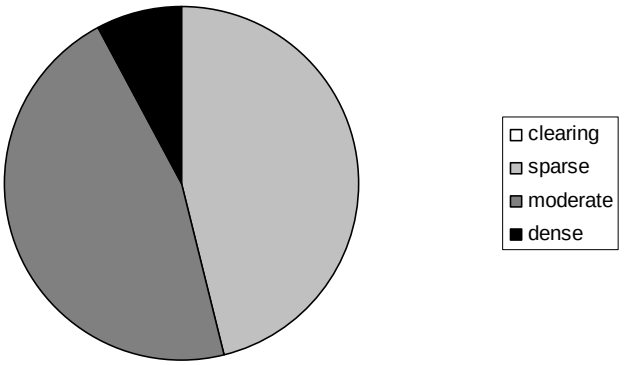

Figure 2: Density of trees at the lynx kill sites in Slovenian Dinaric Mts. (n = 13).
Slika 2: Gostota dreves na mestih, kjer so risi uplenili svoj plen, v Dinaridih v Sloveniji (n = 13).

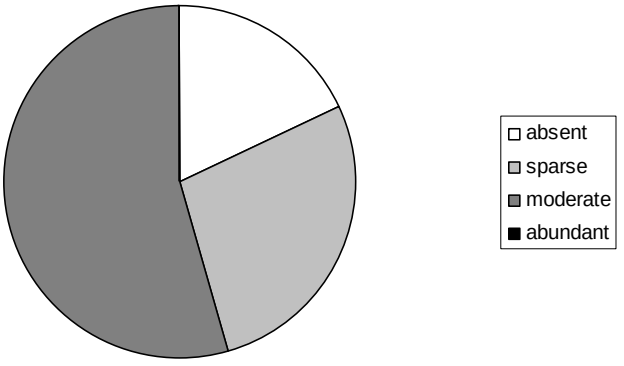

Figure 3: Understory cover at the lynx kill sites in Slovenian Dinaric Mts. (n = 11).
Slika 3: Pokrovnost podrasti na mestih, kjer so risi uplenili svoj plen, v Dinaridih v Sloveniji (n = 11).

Regarding the relief, most of the kills (46%, n = 13) took place in a moderately rugged terrain (Fig. 4). In four cases (31%), we found prey remains in a very rugged terrain, and in three cases (23 %) in unrugged terrain. In 5 out of 13 instances (39%), prey remains were found in dolines.

In cases when the course of the hunt could be determined in successful attacks of lynx on ungulates (n = 11), most of the chases (63%) took place on slopes with more than 10° inclination, 57% of these with the estimated inclination of more than 45° (Fig. 5).

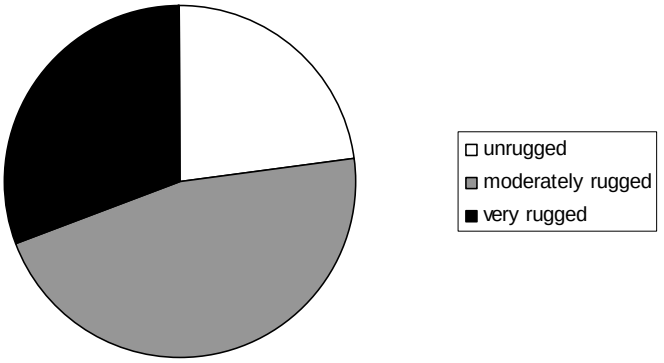

Figure 4: Relief characteristics of the lynx kill sites in Slovenian Dinaric Mts (n = 13).
Slika 4: Razgibanost terena na mestih, kjer so risi uplenili svoj plen, v Dinaridih v Sloveniji (n = 13).

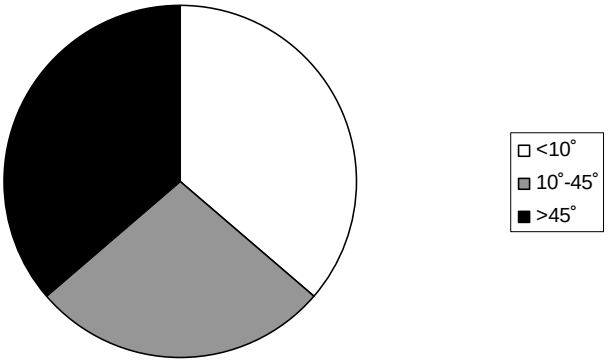

Figure 5: Estimated inclination of the slopes, where the hunt took place for successful lynx attacks in Slovenian Dinaric Mts (n = 11).
Slika 5: Ocenjen naklon pobočja na mestih, kjer so risi lovili svoj plen v Dinaridih v Sloveniji (n = 11).

Discussion

According to our results, Eurasian lynx do not necessarily need dense vegetation for hunting, as they have also successfully captured their prey in places without understory cover and in open forest. However, more data on the characteristics of sites, where the chases were unsuccessful, will have to be collected, to ascertain how vegetation cover affects lynx hunting success. Also the characteristics of kill sites will have to be compared with random sites within the lynx home range to ascertain the degree of selectivity. In addition, it would be interesting to study habitat use of prey animals in the same area, to determine the lynx role in selection of the sites where hunting takes place and how important in this respect is the prey preference for particular habitats. It should be kept in mind that results may be somewhat biased, as there is probably greater probability that prey remains are found at sites with less vegetation, if lynx tracks are unavailable.

Hunting behaviour of most felids usually involves stalking or ambushing their prey and therefore cover might have important role in hunting success, as argued by some authors (Sunquist & Sunquist 1989, Branch 1995; Funston et al. 2001). Contrary to this, Pedersen et al. (1999) noted that Eurasian lynx in Sweden never used dense cover when hunting reindeer (*Rangifer tarandus*). However, in that study lynx rarely stalked their prey and never attacked it from ambush. Also, it must be noted that reindeer lives in large herds and as Sunquist & Sunquist (1989) stated, cover is more important when hunting solitary animals.

Murray et al. (1995) reported that vegetative cover did not affect hunting success of Canadian lynx (*Lynx canadensis*) when hunting snowshoe hare (*Lepus americanus*) in Yukon and that lynx hunted most frequently in sparse forests. Similarly, in Białowieża in Poland Eurasian lynx killed its prey at sites with lower tree density than at random sites (Podgorski 2006). Also, no significant difference was noted there in the amount of understory, forest type or forest age, however, there were more structures advantageous to stalking prey (deadwood, bushes) and lower visibility at kill sites than at random sites. As reported for Kalahari leopards (*Panthera pardus*), which also usually approach their prey with stalking, the vegetative cover is not a limiting factor to hunting success even in arid habitats (Bothma et al. 1994).

In our study, lynx often caught its prey in rugged terrain and on steep slopes. Again, comparison with random sites will have to be made for better evaluation. It could be implied that rugged relief is beneficial to lynx due to their agility and because uneven surface hinder the prey from attaining the maximum speed, which is higher compared to that of lynx (Hucht-

Ciorga 1988). Exception in this regard may be the chamois, which is better adapted to living in rugged terrain and therefore less vulnerable to lynx predation in such areas (Jobin et al. 2000). Rocky ground, which is common in rugged karst landscape, can also enable lynx a more silent approach and vertical structures can provide additional cover when stalking. On the other hand, however, the precipitous craggy terrain can be dangerous for the predator during hunting, especially when hunting large prey (Ross et al. 1995, 1997).

Interesting to note is also the substantial proportion of kill sites in dolines (Fig. 6). One of the reasons for this may be in the tendency of deer to preferentially escape downwards, which was observed in 5 out of 6 cases, when lynx was hunting on an uneven terrain (Krofel 2006). If the hunt takes place in the vicinity of a doline and the prey animal tries to escape downwards, it eventually reaches the bottom. There it does not have any other option but to run upwards, which slows it down and enables the predator to close in for the kill. Besides, during the winter snow often accumulates at the bottom of dolines, and this can additionally slow down the fleeing animal.

Similarly, high frequency of kill sites found in dolines was also recorded for the wolves in the Dinaric Mts in Slovenia (Krofel et al., unpublished data). Because of the cooperative hunting, dolines might have even greater importance for the wolves than for solitary cats, as one pack member may chase prey into a doline, while others circle around and intercept it during the ascent on the other side.

Further research is needed to determine how important these karst structures are in the course of the hunts on ungulates, but it appears that this may be one of the peculiarities of hunting behaviour of large carnivores in the karst areas, such as the Dinaric mountain range.

Figure 6: The doline, where female lynx killed a roe deer (Logatec plateau, central Slovenia).
Slika 6: Vrtača, kjer je risinja uplenila srno (Logaška planota, osrednja Slovenija).

Povzetek

Evrazijski ris se, tako kot velike mačke, pri lovu pogosto približa plenu z zalazom ali pa nanj čaka v zasedi (Kos s sod. 2005). Pri tem je pomembno, da ima na voljo dovolj kritja (Sunquist & Sunquist 1989). V okviru raziskav ekologije evrazijskega risa v Sloveniji ugotavljamo tudi značilnosti mest, kjer so risi uplenili svoj plen. Predstavljamo rezultate preliminarne raziskave, v okviru katere smo ugotavljali reliefne in vegetacijske značilnosti na 13 mestih, kjer so risi uplenili cervide na območju Dinaridov v Sloveniji.

V večini primerov so risi uplenili svoj plen v redkem ali zmerno gostem gozdu (46 % v vsakem). V 55 % primerov so plen uplenili na mestih z zmerno gostoto podrasti, v 27 % v redki podrasti, v 18 % primerov pa podrasti ni bilo. To nakazuje, da ris za uspešen lov ne potrebuje gostega rastja, vendar pa za zdaj še ne moremo trditi, da gostota vegetacije vpliva na lovni uspeh.

46 % mest uplenitve je bilo na območju z zmerno razgibanim terenom, 31 % na predelih z zelo razgibanim terenom, v 23 % pa je bil teren okoli mesta uplenitve nerazgiban. Velik del uspešnih poskusov lova je potekal na strmih pobočjih, in sicer 63 % na pobočjih z ocenjenim naklonom več kot 10° in 36 % na pobočjih z ocenjenim naklonom več kot 45°. Sklepamo

lahko, da je bolj razgiban teren za risa ugoden, ker plen na takšnih predelih teže doseže svojo maksimalno hitrost, ki je večja od risove (Hucht-Ciorga, 1989), do večjega izraza pa pride tudi risova gibčnost. Poleg tega vertikalne skalne strukture dajejo risu možnost kritja, kar mu olajša zalezovanje oziroma čakanje v zasedi, skalnata podlaga pa omogoča tudi tišje gibanje. Vendar po drugi strani skalnat in prepaden teren za plenilca pomeni večjo možnost nesreče in poškodb pri lovu. Še posebej to velja za plenjenje večjega plena, s katerim se mora plenilec potem, ko ga ujame, še nekaj časa boriti, pri čemer se poveča nevarnost poškodb (Ross s sod. 1995, 1997).

Precejšen delež (39 %) mest uplenitev je bil zabeležen v vrtačah. Razlog za to bi lahko bil v tendenci plena, da pogosto beži navzdol, kot smo ugotovili na podlagi sledenja v snegu (Krofel 2006). Če lov poteka v bližini vrtače in lovljena žival zbeži po pobočju navzdol, se kmalu znajde na dnu vrtače, kjer nima druge izbire, kot da beži navzgor, to pa jo upočasni, kar olajša plenilcu, da jo ujame ali podre. Podobno kot pri risu smo ostanke plena večkrat našli v vrtačah tudi pri raziskavah plenjenja volkov na območju Dinaridov v Sloveniji (Krofel s sod., neobjavljeno). Precejšen delež plena, ki smo ga našli na dnu vrtač, kaže na potencialni pomen tega kraškega pojava pri lovu plenilcev na velike sesalce, kar je verjetno ena izmed posebnosti pri plenilskem vedenju zveri na kraških območjih, kot so Dinaridi.

Acknowledgements

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Placobdella costata (Fr. Müller, 1846) (Hirudinea: Glossiphoniidae), a leech species new for Slovenia

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Abstract. The glossiphoniid leech *Placobdella costata* was confirmed in 2006 for the first time in Slovenia at a complex of fish ponds named 'Draga pri Igu' some 10 km south of Ljubljana (Central Slovenia). Up to 15 leeches were found attached to European pond turtles (*Emys orbicularis*), the main host species.

Keywords: *Placobdella costata*, European pond turtle, *Emys orbicularis*, Slovenia

Izvleček. ŽELVJA PIJAVKA *PLACOBDELLA COSTATA* (FR. MÜLLER, 1846) (HIRUDINEA: GLOSSIPHONIIDAE), NOVA VRSTA PIJAVKE ZA SLOVENIJO – Želvja pijavka *Placobdella costata* je bila leta 2006 prvič najdena v Sloveniji v kompleksu ribnikov Draga pri Igu, približno 10 km južno od Ljubljane. Na ujetih močvirskih sklednicah (*Emys orbicularis*), ki so glavni gostitelji, je bilo pritrjenih do 15 pijavk.

Ključne besede: *Placobdella costata*, močvirska sklednica, *Emys orbicularis*, Draga pri Igu, Slovenija

Introduction

The freshwater rhynchobdellid leech *Placobdella costata* is usually considered a Mediterranean species that has spread over large parts of Central and Eastern Europe, reaching as far to the southeast as the southern Arabian Peninsula (Nesemann & Neubert 1999). It is known for its haematophagous ectoparasitic feeding on freshwater turtles, in Europe mainly on *Emys orbicularis*. So far, the species has not been recorded in Slovenia (Sket 1968, 1996), although its discovery has been anticipated owing to a number of records from nearby countries, e.g. Croatia – Istra (Sket 1968), Hungary (Nesemann 1997), Germany

(Grosser 1998). Despite some attention devoted to the European pond turtle in recent years (e.g. Cafuta 2002, Govedič & Janžekovič 2003, Tome 2003), no associations of leeches and turtles have been documented.

Description of the find

Since March 2006, the first author of this article has been involved in field studies of the European pond turtle (*Emys orbicularis*) in an artificial fish pond complex named Draga pri Igu (Fig. 1), situated close to the small town of Ig, approximately 10 kilometres south of Ljubljana (central Slovenia). The fish ponds were established in the 18th century in an old clay pit area. The complex comprises seven small to medium-sized ponds, measuring approximately 15 hectares in total. The bottom and banks are mostly loamy, partly overgrown by reed and other emergent vegetation. A part of the studies covers trapping of pond turtles for radiotelemetric tracking and mark-recapture analysis. Examination of the trapped turtles has led to the first discovery of *Placobdella costata* in Slovenia. The first leech was found on a male's plastron on 15 May 2006 (Fig. 2). Leeches found on two turtles caught on 31 August 2006 were removed and taken to the lab for determination. They are deposited at the Zoological collection of the Department of Biology, Biotechnical Faculty, University of Ljubljana.

Figure 1: The site of the first record of the leech *Placobdella costata* in Slovenia, 'Draga pri Igu' fish ponds (photo: M. Hočevar).
Slika 1: Prvo najdišče želvje pijavke (*Placobdella costata*) v Sloveniji, Draga pri Igu, Veliki ribnik (foto M. Hočevar).

Figure 2: *Placobdella costata* on the plastron of the European pond turtle *Emys orbicularis* found at Draga pri Igu on 15 May 2006 (photo M. Hočevar).
Slika 2: *Placobdella costata* na plastronu močvirske sklednice, najdene v Dragi pri Igu dne 15.05.2006 (foto M. Hočevar).

As many as 15 leeches were found on an injured part of the plastron of a single female turtle (Table 1). All leeches displayed a distinctive bright median dorsal stripe interrupted by four dark sections in the midbody region (Fig. 3). Their ground colour was brown. After fixation with 70% ethanol, two paramedian rows of large, light-coloured papillae became visible. The leeches seemed to differ in their age, or at least in their nutritional condition, as they ranged in size form about one half to two centimetres.

Table 1: Biometric data of *Emys orbicularis* infected by *Placobdella costata*. Measurements are according to Fritz (1995).

Date	**Sex**	**Carapace length** [mm]	**Carapace width** [mm]	**Body mass** [kg]	**No. of leeches**
15 May 2006	male	147	92	0.32	3
15 May 2006	male	136	109	0.41	1
31 Aug 2006	female	168	117	0.78	15
31 Aug 2006	male	118	90	0.32	5

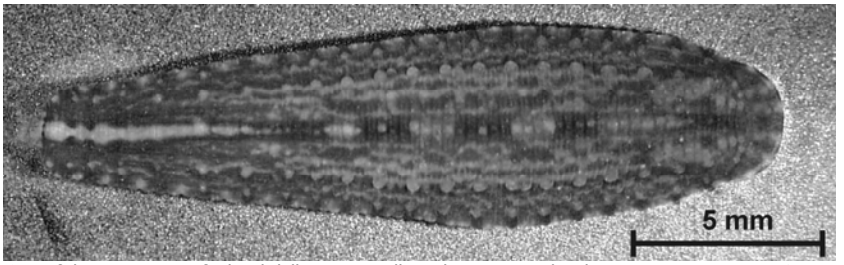

Figure 3: One of the specimens of *Placobdella costata* collected on *Emys orbicularis* at Draga pri Igu on 31 August 2006 (photo C. Fišer).
Slika 3: Eden izmed primerkov *Placobdella costata*, pobranih z močvirske sklednice iz Drage pri Igu dne 31.8.2006 (foto C. Fišer).

Discussion

At the beginning of this millennium, 23 species of leeches were known from Slovenia (Sket 2003). No substantial changes to the Slovenian leech-checklist list were expected at that time. However, only four years after this list has been published, we can assign *Placobdella costata* a tentative number 27. A yet greater increase can be expected once the fish leech (Piscicolidae) fauna is studied under consideration of the taxonomic novelties introduced by Bielecki (1997).

An interesting faunistic question that follows is whether the discovered leeches are newcomers or merely representatives of an overlooked population present here for a long time. Both possibilities are supported by some lines of evidence. The newcomers hypothesis finds support in several recent new discoveries of the species in Central Europe (e.g. Zimmermann 1989, Grosser 1998, Biegel & Grosser 2004). Moreover, it appears that the leech is much more mobile than its host since it is regularly found far outside the range of turtles, which might be possibly explained by occasional switches to more itinerant hosts like beaver (*Castor fiber*) or waterfowl (e.g. Biegel & Grosser 2004, van Haaren et al. 2004). It should be noted that the 'Draga pri Igu' ponds are directly connected to a wider wetland area called Ljubljansko barje, where nutria (*Myocastor coipus*) and muskrat (*Ondatra zibethicus*) abound. On the other hand, the area of Ljubljansko barje was once known for its high numbers of pond turtles, and several decades ago turtles from southeastern regions of the former Yugoslavia were imported (Tome 2003). It seems unlikely that all these turtles had never been parasitized by *Placobdella costata*. The discovery of additional populations in other parts

of Ljubljansko barje or Slovenia would lend credence to the notion that this leech has been around for a longer time.

New or old, there are at least two indications that *Placobdella costata* forms a permanent, reproducing population at the fish ponds of 'Draga pri Igu'. Most important, there is a good population of its primary host, the European pond turtle. Second, leeches of several size classes and possibly different ages were found together on a single turtle.

Povzetek

Sladkovodna želvja pijavka (*Placobdela costata*) velja za cirkummediteransko vrsto, ki je razširjena tudi drugod po srednji in vzhodni Evropi. Kot krvosesa, ektoparazitska pijavka največkrat parazitira na močvirskih sklednicah (*Emys orbicularis*). V Sloveniji še ni bila odkrita, a je bila njena najdba pričakovana glede na številne podatke iz okoliških držav. V okviru raziskave močvirskih sklednic v ribnikih v Dragi pri Igu je bilo ujetih, pregledanih in biometrično obdelanih več želv. Štiri med njimi so imele na sebi želvje pijavke. Največ, 15, jih je bilo 31.8.2006 na samici s 168 mm dolgim karapaksom, katere plastron je bil lažje poškodovan. Želvje pijavke v ribnikih v Dragi pri Igu verjetno oblikujejo večjo, stalno populacijo, ker je v ribnikih precej želv, njihovih glavnih gostiteljev, in ker smo zasledili pijavke različnih velikostnih ter domnevno tudi starostnih razredov. S to najdbo je seznam slovenskih pijavk narasel na 27 vrst.

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Species identity of *Gambusia* (Pisces: Poeciliidae) introduced to Slovenia

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Abstract. On the basis of morphology of the gonopodium and fin ray counts it was determined that the introduced mosquitofish in Slovenia belong to the species *Gambusia holbrooki* Girard, 1859 rather than *G. affinis* (Baird & Girard, 1858). This finding is in accordance with European literature sources but not with Slovene literature, where both taxa are lumped together.

Keywords: Mosquitofish, *Gambusia affinis*, *Gambusia holbrooki*, Slovenia, identification, gonopodium morphology, Invasive Alien Species.

Izvleček. VRSTNA PRIPADNOST GAMBUZIJE (PISCES: POECILIIDAE), VNEŠENE V SLOVENIJO - Na podlagi morfologije gonopodija in števila plavutnic smo ugotovili, da tujerodna vrsta gambuzije, ki se pojavlja v Sloveniji, pripada vrsti *Gambusia holbrooki* Girard, 1859 in ne vrsti *G. affins* (Baird & Girard, 1858). To je tudi v skladu s podatki iz drugih evropskih držav, medtem ko sta se v slovenski ihtiološki literaturi oba taksona obravnavala kot ena vrsta.

Ključne besede: gambuzija, *Gambusia affinis*, *Gambusia holbrooki*, določitev, morfologija gonopodija, invazivna tujerodna vrsta

Introduction

The genus *Gambusia* consists of 45-52 species (Rauchenberger 1989; Eli 2004) two of which are commonly introduced for mosquito control: *Gambusia affinis* (Baird & Girard, 1858) and *G. holbrooki* Girard, 1859. The taxonomic status of these two taxa has been subject of debate until Wooten et al. (1988) argued that they had diverged to a sufficient degree to be treated as separate species. The Slovene populations are usually referred to as *G. affinis* (e.g. Povž & Šumer 2005) but until now no research was carried out to identify which of the two

taxa occurs in Slovenia. However, it is generally assumed that only *G. holbrooki* has been introduced into the Mediterranean region in Europe (Arnold 1990). The purpose of this article is to clarify the identity of *Gambusia* in Slovenia.

Materials and methods

The gonopodiums of preserved adult male Gambusia were viewed under a light microscope and compared with the illustration by Rauchenberger (1989) and the description by Rosen & Bailey (1963). Fin rays of dorsal and anal fins of both adult males and females were counted in specimens from localities where gonopodium morphology varied between individuals. Fin rays were counted as suggested by Walters and Freeman (2000).

Most specimens included in this study originate from the collection of B. Marčeta: Fontanigge, channel between salt pan and airport: 7 males; River Rižana, north of discharge channel: 3 males; Bertoki, ditches between Rižana and Aro Rivers: 5 males and 4 females; Škocjan Inlet: 12 males; Fiesa, larger lake: 12 males; Badaševica, old riverbed that discharges in Škocjan Inlet: 1 male; Skocjan Inlet, Laguna: 1 male. In addition 3 adult males were studied from Koper, ditches near the parking place at the market and three males from Fiesa, smaller lake. These samples cover the entire range of the species in Slovenia. For comparison an adult male from animal trade was included as well (collection P. Veenvliet).

Results

Specimens from all Slovene localities except one have a gonopodium morphology which corresponds with *G. holbrooki* (fig. 1): multiple small spines on the third finray and relatively large hooks on the posterior branch of the fourth finray. One of the five males from Bertoki has a gonopodium morphology that corresponds with *G. affinis*. This particular male has 8 dorsal fin rays, which appears to correspond with *G. holbrooki*. It is also the largest male specimen in the collection. The other 4 males have a gonopodium morphology corresponding with *G. holbrooki* but one has 7 dorsal fin rays which coresponds with *G. affinis*. All 4 adult females have 11 anal fin rays, which corresponds with *G. holbrooki*. However, two of these

females have 7 dorsal fin rays and two females have 8 dorsal fin rays. The single male from animal trade has a gonopodium morphology which corresponds with *G. affinis* (fig. 2): the small spines on the third finray are absent while the hooks on the posterior branch of the fourth finray are relatively large.

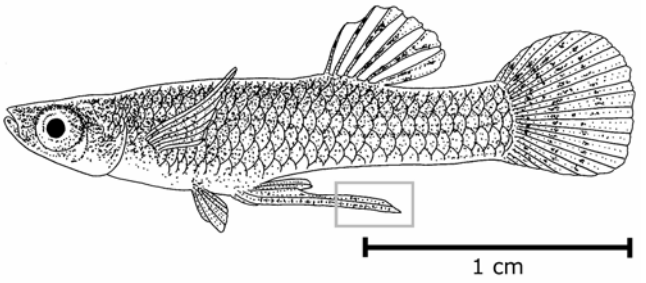

Figure 1: Habitus of a male *Gambusia.* The grey square indicates the tip of the gonopodium, which is shown in figs. 1 and 2. Illustration by Paul Veenvliet.

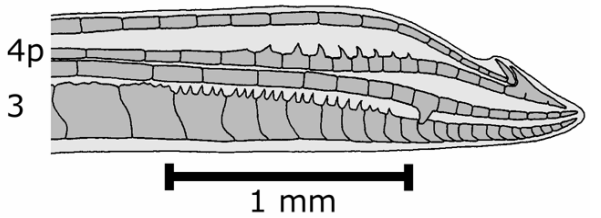

Figure 2: Gonopodium of *Gambusia holbrooki* from Slovenia (Fiesa lake). Numbers refer to finrays: 3 = third finray, 4p = posterior branch of the fourth finray. Illustration by Paul Veenvliet.

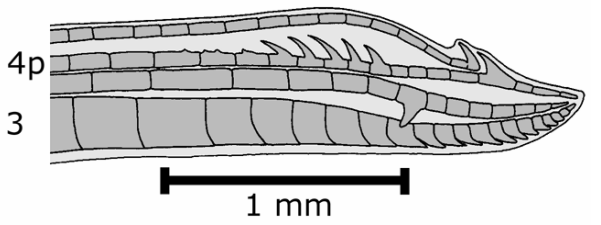

Figure 3: Gonopodium of *Gambusia affinis* from aquarium trade. Numbers as in fig. 2. Illustration by Paul Veenvliet.

Conclusion and discussion

Based on gonopodium characters it is appropriate to refer to Slovene *Gambusia* as *G. holbrooki* and not *G. affinis*. However, gonopodium morphology of one specimen, as well as the variable dorsal fin ray count from other specimens from the same locality may indicate that *G. affinis* is also introduced and has subsequently hybridised with *G. holbrooki*. Alternatively, it is possible that the large male is aberrant and there is within-species variation in the number of dorsal fin rays. Since the four other males from this locality all have a gonopodium morphology that corresponds to *G. holbrooki* it seems appropriate to also refer to this population as belonging to *G. holbrooki* until further research is carried out.

Acknowledgements

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Rakunasti pes ali enok (*Nyctereutes procyonoides*) na Krimu (osrednja Slovenija) – drugi podatek za Slovenijo

THE RACOON DOG (*NYCTEREUTES PROCYONOIDES*) ON M. KRIM (CENTRAL SLOVENIA) – SECOND RECORD FOR SLOVENIA

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Rakunasti pes ali enok (*Nyctereutes procyonoides*) je vrsta Daljnega vzhoda, Kitajske, Koreje, JV Rusije, SV Indokine in Japonske, vendar so ga naselili tudi v zahodnem delu Evrazije (Kauhala 1999). Iz območij v Ukrajini, Belorusiji, Rusiji in Latviji, kjer so vrsto naseljevali med letoma 1929 in 1955, se je enok razširil na zahod; nam najbližje populacije danes živijo na Madžarskem in v Nemčiji. V sosednji Avstriji so prve enoke zabeležili že v 60-ih letih 20. stoletja, največ v severni Avstriji ob nemški in madžarski meji, sicer pa se pojavlja tudi že v severnem predalpskem prostoru (Sackl 2001). V Sloveniji je bila vrsta do pred kratkim poznana le z ene lokalitete, in sicer iz JZ Slovenije, kjer je bil v lovišču LD Gaberk-Divača 25.12.1980 odstreljen en osebek (Kryštufek 1991). Vrsta naj bi se že v začetku 80-ih let, po podatkih v lovski literaturi, pojavljala na Nanosu in Kočevskem, a so bili ti podatki opredeljeni kot nezanesljivi (Kryštufek 1988). Sicer pa je Kryštufek (1991) predvidel, da bi se rakunasti pes glede na razmere v Avstriji lahko pojavil v Prekmurju. In res so prav v tej regiji, natančneje v Murskem gozdu pri Petišovcih, dne 26.12.2004 lovci uplenili en osebek (Marič 2005). Gre torej za dva zanesljiva podatka, vendar oba iz zimskega obdobja, čeprav naj bi bila vrsta pozimi dormantna (Kryštufek 1991, Kauhala 1999).

Dne 19.8.1998 sem ob nočnem pregledovanju gozdnih poti na Krimu blizu vrha Kamenica med Rakitno in vrhom Krima (Gauss-Krügerjeve koordinate: x 5084730, y 5458247) na nadmorski višini 940 m naletel na rakunastega psa, ki je prečkal cesto. Žival je bila kratkonoga, s srebrno sivim in košatim kožuhom ter košatim repom, ki ga je nosila vodoravno. V primerjavi z jazbecem (*Meles meles*), pogosto vrsto na Krimu, je bil rep videti precej daljši, vendar krajši kot pri lisici (*Vulpes vulpes*). Enoka sem opazoval sredi večjega mešanega gozdnega kompleksa s prevladujočimi drevesi smreke (*Picea abies*), bukve (*Fagus sylvatica*) in jelke (*Abies alba*). Čeprav je vrsta izjemno prilagodljiva (Kauhala 1999), je pojavljanje v dinarskem jelovo-bukovem gozdu za to alohtono vrsto presenetljivo, saj so ravno tu zaradi velike pestrosti in številčnosti tako malih kot velikih vrst zveri medvrstni pritiski največji. Kako uspešno bo širjenje areala enoka v južne dinarske gozdne komplekse, bo pokazal čas, kljub temu je bila vrsta pri nas ugotovljena že na treh dokaj oddaljenih lokacijah. Ali gre pri tem za osebke iz naseljene evropske populacije ali zgolj za pobegle osebke iz gojilnic, ni znano, dejstvo pa je, da kljub številnim nočnim obhodom na Krimu v nadaljnjih letih vrste nisem več opazil. Vsekakor gre pri navedenem krimskem podatku za drugo registracijo od treh doslej znanih iz Slovenije.

Zahvala

Zahvaljujem se Mihi Kroflu za literaturo in nasvete.

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Ministarstvo kulture, Državni zavod za zaštitu prirode, Zagreb, 2005. 693 pp. ISBN 953-7169-04-9

Na naš kulturni praznik 2005 se je zgodilo nekaj pomembnega tudi na področju naravovarstva, vendar ne v Sloveniji. V Zagrebu je bila uradna predstavitev novoizdane Rdeče knjige, ki je vsekakor impozantno delo, za pripravo katerega so avtorji (skupno čez 20, z vsaj še enkrat toliko sodelavci) potrebovali kar nekaj let. Izdano delo nadomešča tisto iz leta 1994, ki ga je uredil I. Šugar in je obravnavalo 226 taksonov, medtem ko nova Rdeča knjiga vsebuje obdelave kar 420 taksonov (ki skupaj s premalo poznanimi 340 taksoni predstavljajo celoten Rdeči seznam). Čez 400 obravnavanih taksonov pokriva 9-11% celotne hrvaške flore (ocena je odvisna od tega, ali so podvrste vključene ali ne), kar je delež, ki je primerljiv s prvim slovenskim Rdečim seznamom (Wraber, T. & P. Skoberne, 1989: Rdeči seznam ogroženih praprotnic in semenk SR Slovenije. Varst. Nar. (Ljubljana) 14-15: 9-428.). Ob tem se seveda kar samo zastavlja vprašanje, kaj je razlog za tako nizek delež vključenih vrst (srednjeevropski rdeči seznami vsebujejo 1/4 do 1/3 flore!): dejanska neogroženost ali slabše poznavanje flore?

Čez 70 strani na začetku knjige je namenjenih obširnemu uvodu, ki bralca na jedrnat način seznani s problematiko, najprej na kratko z biogeografskimi, vegetacijskimi in florističnimi značilnostmi Hrvaške, največ uvoda pa je namenjenega podrobni predstavitvi naravovarstvenih tem: metodologiji ocenjevanja ogroženosti, pregledu razlogov ogroženosti in različnim sumarnim pregledom stopnje ogroženosti po posameznih rastiščih, geografskih območjih itd. Veliko prostora je posvečenega predvsem uporabi kriterijev IUCN iz leta 1994, in to metodologijo bi vsekakor morali dosledneje uporabljati tudi v Sloveniji, saj vemo, da je naš veljavni rdeči seznam (Pravilnik o uvrstitvi ogroženih rastlinskih in živalskih vrst v rdeči seznam. Ur. l. RS, št. 82/2002) nastajal precej bolj stihijsko.

Obravnava posameznih vrst je razdeljena v sklope po stopnjah ogroženosti, od izumrlih in kritično ogroženih prek ogroženih do ranljivih. Obdelava posamezne vrste je zelo pregledno strukturirana, z vsaj eno fotografijo in zemljevidom (ki žal prikazuje časovno nediferencirane podatke). Besedilni del je razdeljen v kakih 20 poglavij in dve tabeli, tako da po vrstnem redu pri vsaki predstavitvi lahko preberemo: popolno latinsko ime (kar je tudi naslov strani) s citatom, sinonime, taksonomsko pripadnost, hrvaško ime, IUCN (stara in nova) kategorijo ogroženosti in kriterij za izbor, populacijski trend, regionalno naravovarstveno kategorizacijo, vzroke ogroženosti, naravovarstveni status v sosednjih državah (naš Rdeči seznam je žal zelo nedosledno upoštevan, pa še to le prva verzija), Evropi in svetu, rastišče, ukrepe, opis

taksona, druge podatki o njem, razširjenost na Hrvaškem (s komentiranimi lokalitetami) in Evropi, literaturo, avtorja obdelave (z morebitnimi sodelavci) in posebej ocenjevalca stopnje ogroženosti. Večja preglednost je dosežena s posebnimi sličicami, ki stojijo pred ključnimi poglavji o rastišču, ukrepih, z opisom rastline in razširjenostjo.

V prilogi je še uradna habitatna tipologija, obsežen (okoli 80 strani!) angleški povzetek ter skupni seznam literature in stvarno kazalo (v katerem pa žal manjkajo taksoni s seznama nezadostno poznanih).

Tako obsežno delo seveda ne more biti brez pomanjkljivosti, ki pa vrednosti in pomena knjige skorajda ne zmanjšujejo. Najbolj opazna pomanjkljivost so nekatere neustrezne fotografije, med katerimi jih je največ izposojenih iz tujine (dalje označene z *; in v nekaj primerih v slabo luč postavljajo tudi slovenske botanike!). Tako je bela kljunka (*Rhynchospora alba**) predstavljena z napačno določeno fotografijo, na kateri je verjetno nek mavček (*Trichophorum* sp.), fotografija bolšjega šaša (*Carex pulicaris*) je vsaj slaba, verjetno pa je na njej celo mlad srhki šaš (*C. davalliana*) in ne imenovana vrsta, zelo nerazločna in verjetno napačna je tudi fotografija črnega šaša (*Carex nigra**), barjansko lakoto (*Galium uliginosum**) verjetno predstavlja fotografija razločno drobnocvetne močvirske lakote (*G. palustre*), fotografiji majske prstaste kukavice (*Dactylorhiza majalis**) in mesnordeče sorodnice (*D. incarnata*) sta zamenjani, Kochova vehrica (*Orlaya kochii**) je predstavljena s sliko navadne češljike (*Scandix pecten-veneris*). In seveda še kaka trava: slika navadne vodenke (*Catabrosa aquatica**) je v resnici dišeča šmarna trava (*Hierochloe odorata*), gornja fotografija pri ravenskem trsu (*Saccharum ravennae**) predstavlja tipično socvetje Plinijeve trstike (*Arundo plinii*), plavajočo sladiko (*Glyceria fluitans*) pa predstavlja fotografija nagubane sorodnice (*G. notata=G. plicata*).

Kako pripombo bi zlahka imeli tudi na izbor vrst, tako npr. ni jasno, zakaj je jajčastolistni vimenjak vključen (*Platanthera bifolia*), zelenkasti vimenjak (*P. chlorantha*) pa ne, neofitska vrsta trave *Cutandia maritima* se je na Rabu pojavila pred kakimi 10 leti in je njena vključitev tudi sporna, prav tako ni jasnih razlogov za uvrstitev zakrivljene ozkorepke (*Parapholis incurva*), ki jo srečamo na katerem koli nekoliko slanem rastišču ob morski obali, 3 druge resnično redke in ogrožene vrste tega rodu (*P. strigosa, P. filiformis* iz obmorskih močvirij in *P. marginata* s peščin) pa so izpadle. Z naštevanjem bi lahko nadaljevali v nedogled, a brez pomena. S tem pa smo se dotaknili glavnega konceptualnega problema seznama, ki je problem tudi številnih drugih seznamov, vključno s slovenskim: treba bi jih bilo delati iz dveh smeri. Poleg običajnega pristopa iskanja najbolj ogroženih taksonov bi moralo bilo izhodišče za oblikovanje širšega seznama tudi celoten popis flore nekega območja, s katerega bi črtali

neogrožene vrste, o katerih vemo dovolj. Tako bi nam med nezadostno poznanimi vrstami ostalo bistveno več, na oko bi rekel vsaj kaka tretjina flore, torej v primeru obravnavanega seznama prek 1000 vrst.

Kakorkoli že, predstavljena Rdeča knjiga je za varovanje hrvaške flore in narave močno orodje, hkrati pa bi bilo odlično tudi za osveščanju širše javnosti o tej problematiki. In pri vseh teh nalogah ji želimo v nadaljnjih letih veliko uspeha!

Nejc Jogan

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.

SLIKE IN TABELE
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.

Primeri:

- članke iz revij citiramo:
Schultz J.W. (1987): The origin of the spinning aparatures in spiders. Biol. Rev. 62: 123-134.
Parry D.A., Brown R.H.J. (1959): The hydraulic mechanysm of the spider leg. J. exp. Biol. 36: 654-657.
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.

- knjige, poglavja iz knjig, poročila, kongresne povzetke citiramo:
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.
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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Scientific Paper is a complete description of the original research including theoretical review, research area, methods, detailed presentation of the results obtained and discussion, conclusions and references. The length of the Scientific Paper may not exceed twenty pages.
Short Communication is an original paper without detailed theoretical review. Its purpose is to introduce partial or preliminary results of the research. The length of the Short Communication may not exceed five pages.
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All papers will be subject to peer review by one referee. Authors are invited to suggest the names of referees, although the editor reserves the right to elect an alternative referee to those suggested. The reviewed paper should be corrected by author or authors themselves. In the case of the rejection, the original materials will be sent back to the corresponding author with the editors explanation.

The submitted papers should not have been previously published and should not be simulatenously submiteed or published elsewhere (in other journals, bulletins or congress publications). By submitting a paper, the authors agree that the copyright for their article is transferred to the publisher if and when the article is accepted for publication.

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FORMAT AND FORM OF ARTICLES

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.

Title of paper should be informative, understandable, and concise. The title should be followed by the name(s) and full adress(es) of the author(s), including E-mail adresse(s).

Abstract must give concize information about the objectives, methods used, results and the conclusions. The abstract length should not exceed 200 words for "Scientific Papers" and 100 words for "Short Communications". There should be no more than ten keywords which must accurately reflect the field of research covered in the paper. Field notice does not include abstract and keywords. Author(s) should check the last issue of Natura Sloveniae when preparing the manuscript.

ILLUSTRATIONS AND TABLES

Papers should not exceed a total of ten illustrations and/or tabels, 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).

LITERATURE

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.

Examples (use the the following forms):

- articles from journals:

Schultz J.W. (1987): The origin of the spinning aparatures in spiders. Biol. Rev. 62: 123-134.
Parry D.A., Brown R.H.J. (1959): The hydraulic mechanysm of the spider leg. J. exp. Biol. 36: 654-657.
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.

- for books, chapters from books, reports, and congress anthologies:

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.
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.