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NACIONALNI INŠTITUT ZA BIOLOGIJO

# NATURA SLOVENIAE

Revija za terensko biologijo • Journal of Field Biology

Letnik • Volume 15 Številka • Number 2

Ljubljana
2013

# NATURA SLOVENIAE

## Revija za terensko biologijo • Journal of Field Biology

**Izdajata • Published jointly by**

Biotehniška fakulteta Univerze v Ljubljani
Večna pot 111, SI-1000 Ljubljana
Tel.: (0)1 320 30 00; Telefax: (0)1 256 57 82
http://www.bf.uni-lj.si

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Večna pot 111, SI-1000 Ljubljana
Tel.: (0)59 232 700; Telefax: (0)1 2412 980
http://www.nib.si

http://www.bf.uni-lj.si/bi/NATURA-SLOVENIAE/index.php

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NATURA SLOVENIAE, Večna pot 111, SI-1111 Ljubljana, Slovenija

Izvlečki prispevkov so zavedeni v zbirkah **ASFA, AGRIS, Biological Abstracts, Biosis Previews, COBISS** in **Zoological Records**

**ISSN: 1580-0814** **UDK: 57/59(051)=863=20**

**Lektorji • Language Editors**
za angleščino (for English): Henrik Ciglič
za slovenščino (for Slovene): Henrik Ciglič

**Oblikovanje naslovnice • Layout**
Daša Simčič akad. slikarka, Atelje T

**Natisnjeno • Printed in**
2013

**Tisk • Print**
Miha Košenina s.p., Brezovica pri Ljubljani

**Naklada • Circulation**
300 izvodov/copies

# Kazalo vsebine

NATURA SLOVENIAE 15(2): 5-11
SCIENTIFIC PAPER

Prejeto / Received: 26.7.2013
Sprejeto / Accepted: 3.12.2013

# Yellow goatsbeard *Tragopogon dubius* Scop. (Asteraceae): confirmation of its dubious occurrence in Central Slovenia

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**Abstract.** *Tragopogon dubius* is a species native to SW Slovenia and with several dubious records in central and eastern parts of the country. Its locus classicus is in SW Slovenia at Senožeče, but there is a slight doubt about the type description as no herbarium material has been preserved. All records (and herbarium vouchers in University of Ljubljana's (LJU) collection) of the species from continental Slovenia have been critically assessed, but none of them has proved to be reliable. Three new recently discovered records linked to the railways in central and E Slovenia are presented and discussed.

Key words: *Tragopogon dubius*, Asteraceae, Slovenia

**Izvleček. Velika kozja brada *Tragopogon dubius* Scop. (Asteraceae): potrditev dvomljivih navedb o uspevanju vrste v osrednji Sloveniji** – *Tragopogon dubius* je v submediteranskem delu Slovenije avtohtona vrsta s peščico nezanesljivih navedb o njenem pojavljanju v osrednji in vzhodni Sloveniji. Njeno klasično nahajališče je pri Senožečah, a še vedno obstaja rahel dvom o ustreznosti imena, saj ni ohranjen Scopolijev herbarijski material. Vse starejše navedbe, skupaj s herbarijskim materialom v herbarijski zbirki Ljubljanske univerze (LJU), o pojavljanju vrste v kontinentalnem delu Slovenije so bile kritično pregledane in prav nobena izmed njih se ni pokazala kot zanesljiva. Dodane pa so tri nove nedavne najdbe ob železnici v osrednji in vzhodni Sloveniji.

Ključne besede: *Tragopogon dubius*, Asteraceae, Slovenija

# Introduction

Taxa belonging to the genus *Tragopogon* are easily recognizable by grass-like leaves, big flower-heads and also huge blowballs after the fruits are ripe. For Slovenia, three yellow flowered taxa are reported, namely *T. pratensis* L. ssp. *orientalis* (L.) Čelak. as the only common widespread one and *T. tommassinii* Sch. Bip. and *T. dubius* Scop. mostly confined to the warmer parts of Slovenia under climatic influence of the Adriatic Sea (Wraber & Martinčič et al. 2007). So in the central and eastern parts of Slovenia the expected taxon in every meadow would be *T. pratensis*, but in addition to that, we have some scattered historical records of *T. dubius*, too.

*T. dubius* is a predominantly S European species reaching to Asia Minor to the East (Richardson 1976). In Central Europe, its occurrences are more or less casual and confined to ruderal places, as e.g. in Austria where it is specifically reported for road banks and railway dikes (Fischer 2005). In the territory of Slovenia, there is also a locus classicus of *T. dubius* around Senožeče (Scopoli 1772), the other locality mentioned by Scopoli is Trieste (Italy).

During floristic field mapping, sampling localities are chosen to get as representative sample of habitat-type diversity as possible, so besides natural or semi-natural habitat-types ruderal to completely man-made habitat types are sampled as well. Railway, when present within the mapping area, is particularly important as its traffic is a major vector of plant propagulae, frequent disturbances (trampling, herbicide use) form a specific dry ruderal habitat and especially in the area with predominantly siliceous soils of Eastern Slovenia, railway dikes offer also a niche for calcicolous species.

*T. dubius* was found during floristic mapping in 3 localities. The article discusses the new findings, and all the older published records of the species for Slovenian territory have been critically assessed.

# Material and methods

Mapping of the flora of Slovenia follows the Central-European scheme using the so called MTB grid for stratified sampling (Niklfeld 1971). As the territory of Slovenia covers only about 20.000 $km^2$ and its geomorphology is quite diverse, a standard mapping unit is »the quadrant«, which represents one fourth of the so called base-field and covers about 35 $km^2$ in Slovenia. As the grid is based on geographical coordinates (one quadrant being 5' wide by 3' »tall«), base-fields and quadrants are tapering towards the north, but in the case of Slovenia the size of the mapping units between the extreme north and south differ only by about 2.5%, so the sampled area is well comparable among the quadrants. The quadrant grid is used also for production of standard raster distribution maps (Fig. 1).

*Tragopogon dubius* was recorded during field excursions in Štajerska, Posavje and Ljubljana in the summer 2013. For the preparation of the distribution map, all available data for Slovenia were compiled: published records, herbarium data after revision of material

deposited in LJU (abbreviation followed Index Herbariorum, Thiers 2013), and in addition to that partly unpublished data stored in »Flora Slovenije« database at the Centre for Cartography of Fauna and Flora (CKFF).

For determination, a wide spectrum of floristic works for Slovenia (Martinčič et al. 2007) and neighbouring countries (e.g. Fischer et al. 2005, Kubat 2002, Lauber & Wagner 1996) is used, as well as comparison with already deposited herbarium material in LJU (biggest collection in Slovenia with about 150.000 herbarium sheets).

As *T. dubius* is easily recognizable from other representatives of the genus by its distinctly inflated hollow capitula peduncle, no further determination was needed, but material was collected in the field for the herbarium vouchers, which are deposited in LJU.

## Results and discussion

Among the old records of *T. dubius* for the territory of Slovenia, the majority of them are from the Submediterranean phytogeographical region (SW Slovenia with Adriatic coast and adjacent area) where *T. dubius* is native. Scattered records in other parts of Slovenia have been critically assessed and available herbarium material revised.

Oldest records are those of Maly (1864) for Celje (9757/4) and Reichardt (1860) for Dobrna (9657/3), both reported also by Hayek (1911-14) about half a century later, but never confirmed afterwards. Reichardt is known to be »inventive« in his floristic mapping, and several of his records are indeed totally beyond belief (as already clearly recognized by Pittoni 1877). After a century and a half, Reichard's and Maly's records are of only historical value. So the record in Dobrna is definitely questionable, whereas the occurrence in Celje can be interpreted as an old and a probable one.

In the vicinity, there are three localities of *T. dubius* reported in graduation thesis of Gilčvert (1985; Breg pri Konjicah 9658/4, Špitalič pri Slovenskih Konjicah 9658/4, quadrant 9658/3). Anyway, the only herbarium voucher collected by her and deposited in LJU (Špitalič pri Slovenskih Konjicah) is a wrongly determined *T. pratensis*, so we assume that all three records of *T. dubius* reported by her are most probably erroneous.

Two easternmost localities along the Mura River (Kaligarič 1992; quadrants 9463/1 and 9463/3) are from a manuscript compilation of the E-Slovenian flora without any clear reference or known herbarium voucher, so we can recognize them as questionable. Furthermore, *T. dubius* is mentioned as a questionable taxon for Prekmurje (Bakan 2006) despite the fact that the first of the mentioned quadrants fits the discussed territory, and if the published record of Kaligarič (who was Bakan's supervisor) is reliable, the occurrence of the species would not be questionable at all.

Three localities in Central Slovenia are reported by Janežič (1983; Šenturška Gora, Cerklje na Gorenjskem 9753/1), Majdič (1973; Mrzla draga - Stanišče, Snežnik 0452/2) and student herbarium of Irena Horvat (1989; Turjak, Velike Lašče 0153/2). For a thermophilous species such as *T. dubius* the second reportedly cold locality at over 1,200 m a.s.l. is very unlikely and there is no herbarium voucher. The Šenturška Gora record is not reliable either, as the name »*T. dubius*« is mentioned

only as a host plant of a parasite producing gall, a group that was the main focus of the author. And, of course, student herbaria are generally not very reliable (cf. Jogan & Černač 1998); locality can be falsified or at least determination not very exact and, furthermore, checking of the student herbarium with 150 sheets for a score cannot be very precise either. So another three reported records can be recognized as erroneous or at least questionable.

Judging from the above assessment, the occurrence of *T. dubius* in continental Slovenia should not be very probable. In 2013, however, 3 localities of *T. dubius* were discovered during floristic mappings in some parts of continental Slovenia:

- 9954/2 Slovenija: Posavje, Litija, dry ruderal places at railway station. Leg. N. Jogan, 18. 7. 2013. [46° 3' 26.72" N, 14° 49' 19.35" E]
- 9659/2 Slovenija: Štajerska, dry ruderal places at railway station Slovenska Bistrica (together with a group of students at the Biology Students' Research Camp Rače 2013). Leg. N. Jogan, 23. 7. 2013 [46° 21' 47.86" N, 15° 35' 50.84" E]
- 9952/4 Slovenija: Ljubljana, Rožna dolina, Gregorinova, road bank not far from railway. Leg. N. Jogan, 24. 7. 2013 [46° 2' 40.41" N, 14° 28' 48.69" E]

Obviously all three newly discovered localities are linked to the railway dikes, but none of the plants grew directly on the railway, where several other ruderals such as *Ambrosia artemisiifolia* and cereals frequently occur as a result of direct spread by cereal grain or oil seeds transported in bulk. All three populations were small, having a couple of plants each, but in late July fructification was good and the blowballs with hundreds of achenes were already completely ripe and fruits spread by the wind. All three localities were dry ruderal, with weak vegetation cover and a lot of limestone stones with little soil in between. In none of the localities the occurrence of *T. dubius* could be linked directly to the railway transport, as the plants were 5 to 20 m away from the rails, but still on or near the railway dike.

As *T. dubius* has native populations in the warmer parts of Slovenia, it would not be impossible that the mentioned three populations appeared as a result of seed spread assisted by human (railway transport). But the dispersal of *Tragopogon* is indubitably assisted by wind and it is hard to imagine how such specialized diasporae would attach to some train composition.

So currently we can confirm that *T. dubius* does occur in dry ruderal places in the Prealpine and Subpannonian regions of Slovenia. It is still not clear, however, if it is only a casual there, or whether the populations will persist. Considering the global climatic changes, it is possible that *T. dubius*, too, is one of the thermophilous species widening its distribution from Southern Europe towards more continental parts.

A slight doubt also remains whether Scopoli's description of *T. dubius* really pertains to the species as recognized today, as he did not mention the inflated capitula peduncle (Fig. 1b) as the most prominent character (the only European yellow flowering species of the genus with this character; Richardson 1976). In fact, Scopoli (1772) explicitly distinguished *T. dubius* from *T. pratensis* by: 1) leaves not undulate nor their apex tendril-like, leaf base not inflated, 2) stem not branched, 3) involucral bracts longer than radial florets, and 4) capitula (not measuring involucral bracts) an inch wide. Length of involucral bracts is a character used also nowadays related to the capitula diameter, leaf structure is simply not mentioned anymore and branching of stem is variable and in both species the stem can be simple or branched. The problem is that no herbarium material collected by Scopoli has been preserved, so we must rely on distribution data, selected parts of description and the fact that only two species of the genus were mentioned by Scopoli for Carniola.

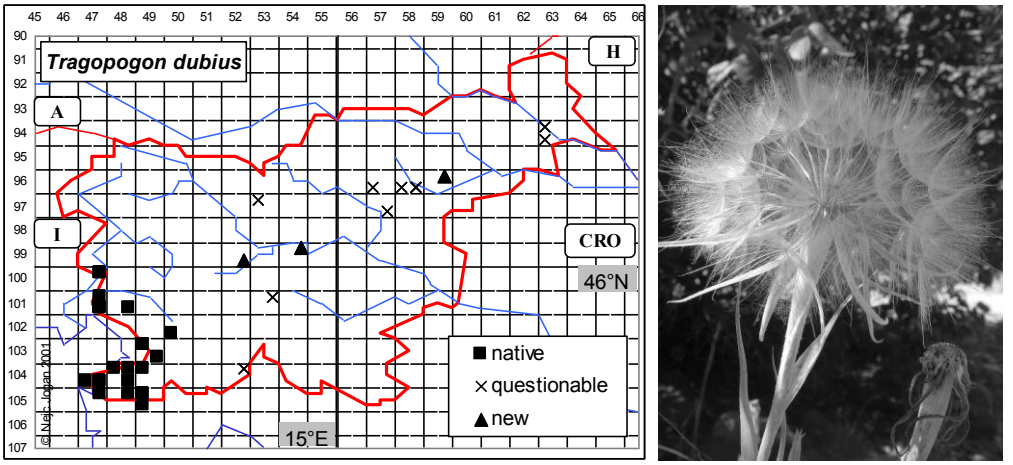


**Figure 1.** Left: distribution map representing native occurrence of *T. dubius* (black squares), questionable records discussed in the text (X), and three newly discovered localities (black triangle). Right: blowball with distinctly inflated peduncle in the locality at Slovenska Bistrica (foto: N. Jogan).
**Slika 1.** Levo: zemljevid razširjenosti *T. dubius* prikazuje naravno razširjenost (črni kvadratki), vprašljive navedbe, ki so podrobneje razložene v besedilu (x), in tri novoodkrita nahajališča (črni trikotniki). Desno: »lučka« z razločno razširjenim vrhom koškovega pecljа, slikano na lokaliteti Slovenska Bistrica (foto: N. Jogan).

A neotypification of *T. dubius* is needed, but a clear relation between *T. major* Jacq., described just a year later by Jacquin (1773), with whom Scopoli was in good contacts, needs to be clarified. This is important also as a very detailed picture, which can easily serve as a type, was published by Jacquin (ibid., tabula 29), clearly depicting a plant that would currently be named *T. dubius*. Its locality is not mentioned, but the habitat type described as »ad margines sylvarum, ad vias ...« clearly shows ruderal tendency. The possibility that the description of Scopoli (1772) simply pertains to another taxon (e.g. *T. tommasinii* with distribution range covering Senožeče and Trieste as loci classici mentioned by Scopoli) is still high and in this case »*T. major*« would be the oldest available name for the taxon discussed herewith.

## Povzetek

*Tragopogon dubius* je ena od treh rumenocvetočih vrst kozje brade, ki jih navajajo za Slovenijo. Sam rod je v nasprotju s številnimi drugimi radičevkami zlahka prepoznaven po »travastih« listih, enoredno nameščenih listih ovojka in orjaških »lučkah«, ki jih ob zrelosti oblikujejo rožke z dolgim kljuncem in razprostrto kodeljico peresastih laskov. *T. dubius* se pojavlja predvsem v južni Evropi in vse do Male Azije, v Sloveniji velja za avtohtono vrsto na Primorskem, kjer se pojavlja tudi na travišcih, v notranjosti Slovenije pa se zdi pojavljanje sekundarno in vezano na motena rastišča. Tri novoodkrite najdbe, ki jih obravnava članek, so bile vse vezane na železnico, vendar se same populacije niso pojavljale neposredno na progi, ampak na območju železniških nasipov, tako da je težko reči, kako se je vrsta tod pojavila. Po odkritju treh novih lokalitet so bili kritično pregledani tudi vsi starejši podatki o pojavljanju te vrste v notranjosti Slovenije in izkazalo se je, da najverjetneje ni nobene zanesljive najdbe iz preteklosti. Najstarejša podatka iz srede 19. stoletja s Štajerske imata seveda le še zgodovinsko vrednost, nikdar

kasneje ni bilo pojavljanje vrste tam potrjeno. Podatki iz okolice Slovenskih Konjic so rezultat diplomske naloge Gilčvert (1985), vendar pa je edini dokazni herbarijski primerek napačno določen, torej so vsi trije podatki nezanesljivi. Prav tako so nezanesljivi podatki iz Pomurja (Kaligarič 1992), kar posredno nakazuje tudi Bakan (2006). Nadalje je podatek s Turjaka iz študentskega herbarija in kot tak načeloma nezanesljiv, edini podatek z Gorenjske se nanaša le na gostiteljsko rastlino rastlinske šiške (Janežič 1983) in ob drugam usmerjenem poudarku raziskave prav tako ni zanesljiv, mraziščna lokaliteta pod Snežnikom (Majdič 1973) pa je že po ekoloških razmerah popolnoma neverjetna. Tako lahko sklenemo, da se obravnavana vrsta na območju osrednje Slovenije sicer zanesljivo pojavlja, vendar pa so vse stare navedbe nezanesljive ali napačne. Trenutno ni jasen status novoodkritih populacij, utegnile bi se pojavljati le prehodno, a v povezavi z globalnim spreminjanjem klime ni izključeno tudi trajno širjenje vrste v notranjost.

Še vedno pa ostaja odprto vprašanje, ali se Scopolijev (1772) opis dejansko nanaša na takson, ki mu danes pravimo *T. dubius*, saj so trije od navedenih štirih razlikovalnih znakov pri kozjih bradah znotrajvrstno variabilni, in tudi ovojek, ki po dolžini presega cvetove, se lahko pojavlja pri skupini travniške kozje brade, npr. pri *T. tommasinii*.

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NATURA SLOVENIAE 15(2): 13-22
SCIENTIFIC PAPER

Prejeto / Received: 15.6.2013
Sprejeto / Accepted: 5.7.2013

# New records and unusual morphology of the cave hydrozoan *Velkovrhia enigmatica* Matjašič & Sket, 1971 (Cnidaria: Hydrozoa: Bougainvilliidae)

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**Abstract.** *Velkovrhia enigmatica* is the only freshwater hydrozoan living exclusively in groundwater. It is endemic to the Dinarides in the Balkan Peninsula, where it has been known from four caves only. Here we report on a new *V. enigmatica* population from cave Logarček near Laze in southwestern Slovenia. In addition, after almost 30 years since its last recorded presence, we confirm the current presence of numerous *V. enigmatica* individuals in the type locality, Planinska jama. Individuals from the two caves were morphologically different: polyps from the type locality had 4–9 tentacles, while the ones from Logarček had 14–36 tentacles. The mitochondrial DNA sequences in populations from both caves did not differ. Additional research is needed to provide further insights into species taxonomy, biology and distribution.

Key words: *Velkovrhia enigmatica*, Hydrozoa, Planinska jama, Logarček, morphology

**Izvleček. Nove najdbe in nenavadna zgradba velkovrhije *Velkovrhia enigmatica* Matjašič & Sket, 1971 (Cnidaria: Hydrozoa: Bougainvilliidae) –** *Velkovrhia enigmatica* je edini sladkovodni trdoživnjak, ki živi izključno v podzemeljskih vodah. Doslej so tega endemita Dinarskega krasa na Balkanskem polotoku našli le v štirih jamah. V prispevku poročamo o najdbi nove populacije v jami Logarček pri Lazah v jugovzhodni Sloveniji. Poleg tega lahko, po skoraj 30 letih, ponovno potrdimo pojavljanje velkovrhije na tipski lokaliteti v Planinski jami. Osebki iz obeh jam se medsebojno morfološko razlikujejo: polipi iz tipske lokalitete imajo 4–9 lovk v primerjavi s polipi iz Logarčka s po 14–36 lovkami. V zaporedjih mitohondrijske DNA obeh populacij ni razlik. Šele z dodatnimi raziskavami bi lahko izboljšali vpogled v taksonomijo, biologijo in razširjenost te vrste.

Key words: *Velkovrhia enigmatica*, Hydrozoa, Planinska jama, Logarček, morfologija

# Introduction

*Velkovrhia enigmatica* Matjašič & Sket, 1971 belongs to the predominantly marine family Bougainvilliidae. It is the only freshwater hydrozoan living exclusively in groundwater, even though some surface-dwelling species of the family Hydridae can occasionally be found in groundwater as well (Zagmajster et al. 2011). The species was first discovered in the Rak channel in Planinska jama (near Planina, southwestern Slovenia; Matjašič & Sket 1971). Three caves were reported later: Krška jama (near Krka, southeastern Slovenia), Tounjčica (near Ogulin, central Croatia) and Vjetrenica (near Zavala, southern Bosnia and Herzegovina), all in the Dinarides in the Balkans (Velikonja 1986).

*Velkovrhia enigmatica* is a small colonial hydrozoan, with polyps from 1.3 to 1.7 mm in height, growing about 2–5 mm apart from the common stolon up to 15 mm long (Matjašič & Sket 1971). The stolon and polyps are covered with thin multilayered perisarc terminating below the hydranths, which have typically 5–10 weakly contractible tentacles (Matjašič & Sket 1971). With the exception of the type locality, only single records of the species are available for each of the other three caves (Velikonja 1986). In Tounjčica, live colonies were found on stones in small pools of water. In Krška jama, two pieces of stolons with single polyps were found in the basket of an artificial substrate sampler in the cave, while a report from Vjetrenica refers only to one polyp found in the tank where water and material collected in the cave was put (Velikonja 1986, Sket pers. comm.). In Planinska jama, individuals were found exclusively in the Rak channel. Most animals were found in a conglomerate, with their stolons overgrowing permanently submerged surfaces of the stone agglomerates. A few stolons were reported also from stones, exposed at low water levels (Matjašič & Sket 1971).

During the first 15 years after its discovery, studies on species ontogeny (Sket & Matjašič 1977, Velikonja 1986), morphology (Kuštor 1977), and seasonal dynamics (Velikonja 1986) were conducted. As the access to the animals in Planinska jama has often been limited due to high water levels, *V. enigmatica* was brought into the laboratory and successfully bred (Velikonja 1986). After this period, studies on the species biology stopped and there was no further confirmation of the species inhabiting the cave.

Here we report on a new locality of *V. enigmatica* with an unusual morphology as well as confirm the presence of the species at its type locality.

# Material and Methods

## Description of the caves

Logarček (Cad. No. 28; Slovenian Cave Register 2012) is a multilevel cave with over 4.4 km passage length and 120 m vertical extent, with permanent underground waters in the deepest corridors. Its entrance is located close to Laze village near Planina (Lat.: 45.864947, Long.: 14.268217, 499 m a.s.l.; Slovenian Cave Register 2012). The entrance is a 20 m vertical shaft, followed by about 200 m long corridor that splits into large southern and

northern corridors (Južni kanal and Severni kanal, respectively), each with several side channels (Ilič 2012). Both corridors contain water lakes and siphons at their deepest parts (Ilič 2012). Waters in the cave derive partly from Planinsko polje, a large karst polje close to Planina village, via various sinks of the river Unica, especially during floods in the polje (Gams 1963, 2003, Gabrovšek & Turk 2010).

Planinska jama (Cad. No. 748; Slovenian Cave Register 2012) is a horizontal cave with over 6.6 km passage length and 65 m vertical extent. Its entrance is situated at the southwestern part of Planinsko polje (Lat.: 45.819900, Long.: 14.245667, 453 m a.s.l.; Slovenian Cave Register 2012). The cave consists of two large channels with the underground Rak and Pivka rivers of different hydrological origins. The Pivka sinks underground in Postojnska jama near Postojna, about 5 km south-west from its underground siphon at the deepest point of the Pivka channel in Planinska jama. The Rak sinks underground in Tkalca jama, after its 2 km surface flow on the small karst polje Rakov Škocjan. Its waters originate from the intermittent lake Cerkniško jezero, 5 km north-west from Rakov Škocjan. The river reappears in the Rak channel in Planinska jama, together with the subterranean waters originating from the Javorniki mountains in the south. The subterranean flows of the Rak and Pivka rivers in Planinska jama meet and join 2.5 and 3 km from their respective siphons, to form the Unica river. The latter continues its subterranean flow for about 500 m and emerges from Planinska jama to Planinsko polje. The Rak and Pivka rivers differ in their yearly temperature fluctuations, as well as in the amount of organic material they contain: they are both lower in the Rak than in the Pivka river (Sket 1970).

## Field work

We investigated both corridors of Logarček up to their siphons on 23. 2. 2012, while on 9. 3. 2012 we checked only the northern corridor up to the lakes in Skalni rov, about 600 m from the cave entrance. In Planinska jama, the entire Pivka and Rak channels were investigated on 2. 6. 2011 and 14. 2. 2012 up to the lake Dvojno jezero some 400 m upstream from the confluence of both rivers.

During the first visits to both caves, general inventory of the cave fauna was performed by visual inspection and macroscopic collecting methods. A detailed examination of various water bodies, like drip pools, sinking streams, shores of rivers and lakes was carried out. Some individuals of *V. enigmatica* were carefully collected from the rocks and stored in 96% ethanol at the collecting site. A few living individuals from Planinska jama were transferred to the speleobiological laboratory of the Department of Biology (Biotechnical Faculty, University of Ljubljana), where some of them were later preserved in 96% ethanol.

We photographed the animals *in situ* and measured some water characteristics during our second visit. In Logarček, only water temperature was measured in the lake in Skalni rov, using a portable hand thermometer. Conductivity, pH, oxygen saturation and particle concentration of the water were measured three days later in the laboratory, using portable multimeter Eutech PCD650. In Planinska jama, all parameters were measured in the cave using the same equipment.

## Molecular work

Genomic DNA was extracted from two individuals from Planinska jama (BA001, BA002) and Logarček (BA003, BA004), using GenElute Mammalian Genomic DNA miniprep Kit (Sigma-Aldrich). About 600 bp of the large mitochondrial ribosomal RNA gene (16S) was amplified, using 16S SHA and 16S SHB primers (Cunningham & Buss 1993). PCR was performed using the following settings: 30 s at 94°C, 45 s at 50°C, 120 s at 72°C, for 35 cycles followed by final extension at 72°C for 10 min. After purification, the gene fragment was sequenced in both directions, using the same primers by Macrogen Europe. Sequence chromatograms were edited in Geneious ver. 5.5.6 (Biomatters Ltd.). The GenBank Accession number for *Velkovrhia enigmatica* is KF312212.

# Results

We found numerous individuals of *V. enigmatica* in Logarček and Planinska jama, confirming a permanent presence of the species in both caves. Logarček is a new locality for the species, which is now known from five caves in the Dinarides (Fig. 1).

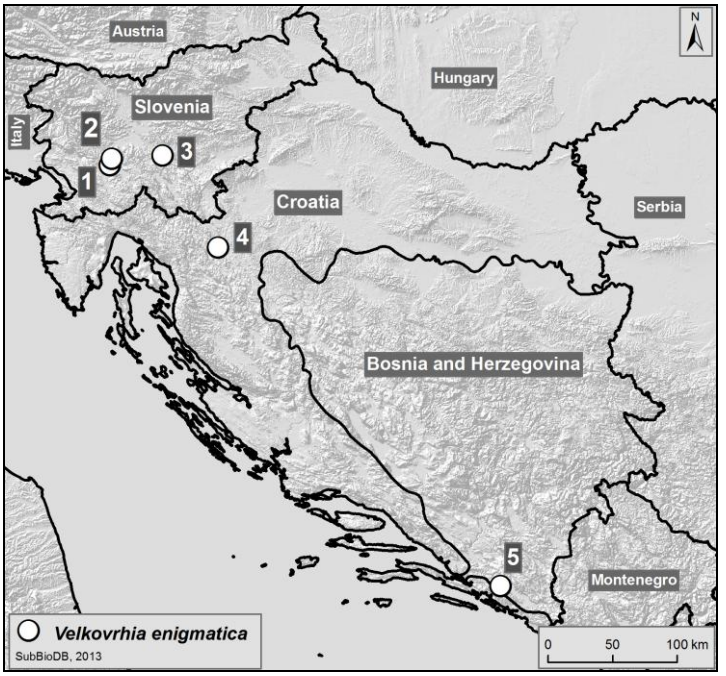


**Figure 1**. Caves where *V. enigmatica* was found: 1 – Planinska jama, 2 – Logarček, 3 – Krška jama, 4 – Tounjčica, 5 – Vjetrenica.
**Slika 1.** Jame, kjer je bila najdena velkovrhija: 1 – Planinska jama, 2 – Logarček, 3 – Krška jama, 4 – Tounjčica, 5 – Vjetrenica.

In Logarček, we found many polyps in the lake in Skalni rov, about 600 m from the cave entrance. In February 2012, they were attached to the submerged rocks, 10 cm or deeper below the lake surface. In March 2012, the water level was 10 cm higher. The lake was about 20 m long and 6 m wide, with the estimated maximum depth of about 1 m in its centre. Rocks with *V. enigmatica* in the southern and northern parts of the lake were partially covered by a thin layer of mud. During a thorough check of all accessible rocks in the lake, altogether 90 polyps were counted: 60 polyps growing from at least five stolons at the southern part of the lake, and 30 polyps growing from at least three stolons from its northern part (at the time we did not record the exact number of stolons).

In Planinska jama, *V. enigmatica* was found at two sites in the Rak channel. Only one polyp was found in a small water puddle on the rock that was separated from the main Rak flow due to the low water level. The rock was situated between Velika dvorana and Rudolfovo pristanišče, about 250 m from the confluence of the Rak and Pivka rivers. However, at least 50 stolons with polyps were found in the small cave water tributary, merging with the Rak river on its left bank in the close proximity to the lake Dvojno jezero, about 400 m upstream from the confluence. Stolons with polyps (Fig. 2) were overgrowing conglomeratic stones of different sizes, which lay in low water and in puddles, as well as the glass plates found in the tributary. Characteristics of water in the Rak river near Dvojno jezero were very similar to those of the lake in Skalni rov in Logarček (Tab. 1).

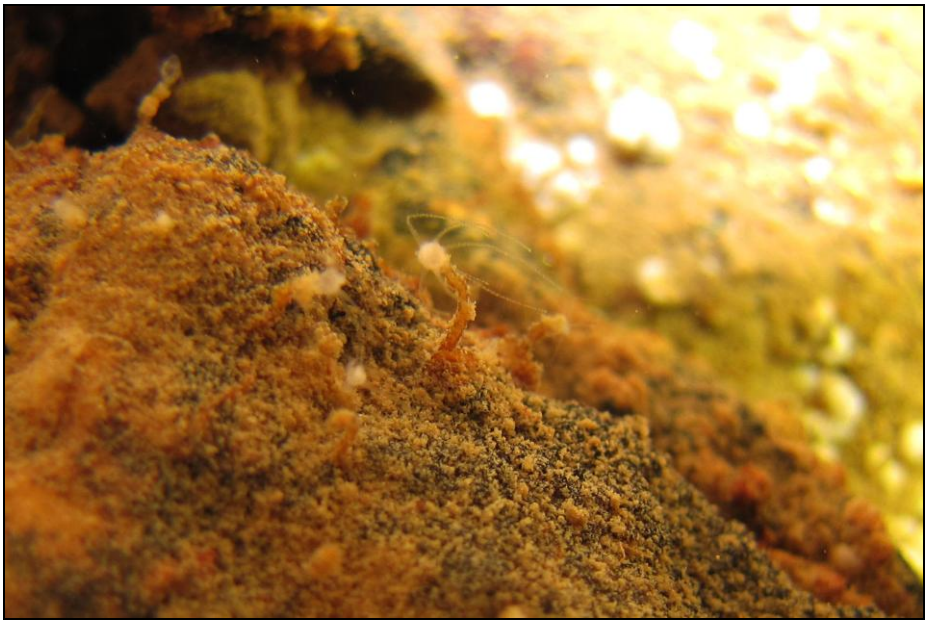

**Figure 2**. *Velkovrhia enigmatica* photographed in the small tributary of the Rak river in the Rak channel of Planinska jama (photo: Rodrigo L. Ferreira).
**Slika 2.** Velkovrhija, slikana v majhnem pritoku reke Rak v Rakovem rokavu Planinske jame (foto: Rodrigo L. Ferreira).

**Table 1.** Chemical characteristics of water of the Rak river near Dvojno jezero in Planinska jama and of the lake in Skalni rov in Logarček
**Tabela 1**. Kemične lastnosti vode v Raku pri Dvojnem jezeru v Planinski jami in v jezeru v Skalnem rovu v Logarčku

| | **Logarček** | **Planinska jama** |
|---|---|---|
| Date | 9. 3. 2012 | 14. 2. 2012 |
| T (°C) | 8.2 | 8.3 |
| pH | 7.67 | 7.72 |
| Conductivity (µS) | 314.8 | 361.8 |
| Part. concentration (ppm) | 282.9 | / |
| $O_2$ (%) | / | 91.3 |

Polyps collected in both caves differed substantially in the number of tentacles on their hydranths. While the ones from Planinska jama had up to 9 tentacles (4–9, N=19; Fig. 2), the count of tentacles in two polyps from Logarček was 36 in one and at least 14 in the other (damaged one). The maximum number of tentacles that could be counted from the photographs of 12 different polyps from the latter cave was about 22 (Fig. 3).

**Figure 3**. *Velkovrhia enigmatica* with large number of tentacles, photographed in the lake in Skalni rov in Logarček (photo: M. Zagmajster).
**Slika 3.** Velkovrhija z velikim številom lovk, slikana v jezeru v Skalnem rovu v Logarčku (foto: M. Zagmajster).

According to the molecular results, all individuals from Planinska jama and Logarček had exactly the same 16S sequence without indication of any genetic variability. Therefore, specimens from Logarček were identified as the same species.

## Discussion

The discovery of *V. enigmatica* in Logarček represents the fifth locality of the species, whose distribution is still poorly known (Velikonja 1986). Besides waters coming to the cave from Planinsko polje, waters in the northern corridor may originate partly also from Cerkniško jezero, as is the case in the nearby cave Vetrovna luknja (Gabrovšek & Turk 2010). The new locality indicates the possibility that the species might be present also in other caves in the region between Cerkniško jezero and Planinsko polje, especially the ones that are drained by the subterranean waters of the same source, Cerkniško jezero (Gabrovšek & Turk 2010).

However, the difficulty in detecting the species poses a challenge in improving the knowledge on its distribution. *Velkovrhia enigmatica* is a small, hardly visible hydrozoan that can easily be overlooked in the caves during usual visual inspection. In addition to a thorough and careful search, low water level is also a prerequisite for a potentially successful sampling. In Planinska jama, we found *V. enigmatica* at the site that was known also at the time of its description, as we found also glass plates probably set in the stream by the late M. Velikonja during his studies of the species' biology (Sket, pers. comm.). As several individuals were observed on the glass plates, and there are no known reports on significant changes in the Rak river water quality, it is not likely that the absence of records in recent decades is due to temporary disappearance of this population from the site.

Individuals found in the type locality had the same number of tentacles as the ones in the original description by Matjašič & Sket (1971). Individuals from Logarček, however, had at least two but also more than three times higher number of tentacles, while no genetic differences between both populations was detected. This is the first observation of such great variation in tentacle number in *V. enigmatica*; so far, only annual variation in hydranth density has been reported (Velikonja 1986).

The number of tentacles in hydrozoans is known to depend on different factors. The Rak river in Planinska jama is low in organic matter (Sket 1970, Matjašič & Sket 1971), and it was shown that low food resources can lead to loss of tentacles in *Hydra* species (Berninger 1910, Kepner & Jester 1927). But, as waters in the Northern corridor of Logarček are very likely fed by the same source as in the Rak channel of Planinska jama, differences in the organic matter could be regarded as not substantial. Loss of tentacles in hydrozoans can result also from high temperatures (Annandale 1907), which can be excluded in the case of the subterranean Rak river with almost no seasonality (Sket 1970, Matjašič & Sket 1971). At both sites, chemical properties of water at the time of our second sampling were similar, so differences in the morphology cannot be easily explained by permanent differences of water. The increase in number of tentacles in Logarček seems to be site specific and could be also temporary, as there are no records of higher tentacle number in the other three populations of *V. enigmatica* in the Dinarides (Velikonja 1986). During both visits, we recorded a water drip with the increased salinity (13‰) in the side channel of the Northern corridor in Logarček, probably due to the salt spread on the highway above the cave in winter (Zagmajster et al., in prep). Even though that site is about 250 m straight line distance from the lake with *V. enigmatica*, a possibility of temporary salt inputs cannot be completely ruled out. It has been shown that unfavourable hydrogen ion concentration results in a changed number of tentacles in some

*Hydra* species (Threlkeld & Hall 1928). Also, in the case of the brackish water hydroid *Cordylophora caspia* (Pallas, 1771), both the morphology and ecology change drastically in varying salinities – in higher salinity the tentacle number is higher (Kinne 1957, Smith et al. 2002). At present, all of these possibilities are just speculations, which should be verified by further monitoring of species at both localities and by conducting experimental studies. Such findings of species indicate the lack of knowledge and warrant continuation of studies on taxonomy, biology and distribution of this world unique subterranean species.

## Povzetek

Jamski trdoživ ali velkovrhija, *Velkovrhia enigmatica* Matjašič & Sket, 1971, pripada pretežno morski družini Bougainvilliidae. Je edini sladkovodni trdoživnjak, ki živi izključno v podzemeljskih vodah (Zagmajster et al. 2011), čeprav lahko tam najdemo tudi nekatere vrste iz družine Hydridae. Velkovrhija je bila najprej odkrita v Rakovem rokavu Planinske jame (pri Planini, jugovzhodna Slovenija), kasneje pa še v Krški jami (pri vasi Krka, jugovzhodna Slovenija), Tounjčici (pri Ogulinu, Hrvaška) in Vjetrenici (pri Zavali, Bosna in Hercegovina) (Velikonja 1986). Je majhen kolonijski trdoživnjak, s polipi, ki izraščajo iz skupnega stolona. Vse razen čašastega hidranta obdaja tanek perisark, iz hidranta pa izrašča 5–10 slabo krčljivih lovk (Matjašič & Sket 1971). Z izjemo tipske lokalitete predstavljajo podatke iz vseh ostalih jam le enkratne najdbe. Raziskovanje ontogenije (Sket & Matjašič 1977, Velikonja 1986), morfologije (Kuštor 1977) in sezonske dinamike (Velikonja 1986) je potekalo v prvih 15 letih po odkritju, predvsem na osebkih, gojenih v jamskem laboratoriju Oddelka za biologijo, Biotehniške fakultete, Univerze v Ljubljani (Velikonja 1986). Pozneje podatkov o velkovrhiji v naravi ni več moč najti.

Na podlagi terenskih raziskav v letih 2011 in 2012 podajamo nove podatke o razširjenosti velkovrhije v dveh jamah v okolici Planinskega polja. Logarček (kat. št. 28, Jamski kataster Slovenije 2012) je večnivojska jama, dolga 4,4 km, ki se 200 m za vhodnim breznom razdeli v Severni in Južni kanal (Ilič 2012). Planinska jama (kat. št. 748, Jamski kataster Slovenije 2012) je 6,6 km dolga jama, ki jo sestavljata dva velika podzemna rokava s ponikalnicama Rakom in Pivko, ki se v jami združita v reko Unico. V Logarčku smo 23. 2. 2012 raziskali Severni in Južni kanal, medtem ko smo 9. 3. 2012 pregledali le Severni kanal do jezerc v Skalnem rovu. Planinsko jamo smo raziskali 2. 6. 2011 in 14. 2. 2012, ko smo poleg Pivškega rokava raziskali tudi Rakov rokav do Dvojnega jezera. Živali smo nabirali ročno in jih spravljali v 96 % etanol. Pozneje smo izolirali mitohondrijsko DNA iz po dveh osebkov iz vsake jame.

Logarček je peta jama, od koder je znana velkovrhija. Veliko polipov smo našli v jezeru v Skalnem rovu, in sicer pritrjenih na potopljene skale, ponekod prekrite s tanko plastjo blata. Našli smo 90 polipov, ki so izraščali iz najmanj osmih stolonov (v času popisa stolonov nismo natančno šteli). V Planinski jami smo velkovrhijo našli na dveh mestih v Rakovem rokavu. En sam polip smo opazili v lužici na skali med Veliko dvorano in Rudolfovim pristaniščem. Vsaj 50 stolonov s številnimi polipi pa smo našli na konglomeratu in na steklenih ploščicah v manjšem levem pritoku reke Rak, v neposredni bližini Dvojnega jezera. Kemične lastnosti vode v jezeru v Skalnem rovu in v reki Rak pri Dvojnem jezeru se med seboj niso bistveno razlikovale. Število lovk na fiksiranih polipih iz obeh jam je bilo bistveno različno: tisti iz Planinske jame so imeli do 9 lovk (4–9; N=19), medtem ko je imel en polip iz Logarčka 36 lovk, poškodovani polip pa vsaj 14. Na fotografijah iz Logarčka je bilo mogoče na polipih prešteti do 22 lovk. Ker se populaciji velkovrhij iz obeh jam med seboj genetsko ne razlikujeta, je mogoče, da so razlike v številu lovk posledica različnih biotskih ali abiotskih faktorjev. Le dodatne raziskave bi omogočile boljši vpogled v taksonomijo, biologijo in razširjenost vrste, kot tudi razumevanje ozadja opaženih morfoloških razlik.

## Acknowledgements

We are very grateful to Rodrigo L. Ferreira (University of Lavras, Brasil) for contributing the photograph of *V. enigmatica* from Planinska jama and Peter Schuchert (Muséum d'histoire naturelle, Geneva, Switzerland) for his suggestions about the primers. Extensive help in field work was offered by (in alphabetical order): Rodrigo L. Ferreira, Marjeta Konec, Marconi S. Silva and Peter Trontelj. We are grateful to Boris Sket and Peter Trontelj for comments on the earlier versions of the manuscript. The study was supported by the Slovenian Research Agency (program Zoology and speleobiology No. P1-0184, and bilateral project Slovenia-Brasil No. BI-BR/11-13-006).

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NATURA SLOVENIAE 15(2): 23-38
ZNANSTVENI ČLANEK

Prejeto / Received: 28.4.2013
Sprejeto / Accepted: 31.5.2013

# Prispevek k recentni razširjenosti, ekologiji in varstvu močvirske sklednice *Emys orbicularis* (Linnaeus, 1758) v Beli krajini (JV Slovenija)

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**Izvleček.** V Beli krajini je močvirska sklednica glede na starejše podatke splošno razširjena, toda novejših podatkov o razširjenosti za to vrsto ni, kaj šele podatkov o njeni ekologiji. Med letoma 2008 in 2012 smo raziskali ekologijo, stanje populacije in razširjenost te vrste v Beli krajini na stoječih vodah in izvirih. Vrsta je bila potrjena v primarnih in sekundarnih vodnih habitatih na štirih večjih območjih. Od 48 ujetih želv jih 40 % spada med osebke, stare do deset let. Razmnoževanje smo potrdili na petih lokacijah (Prilozje, Zjot, Golek, mrtvica Obrha, Nerajec). V kalu Golek in Gornjem kalu smo zabeležili mesta, kjer želve odlagajo jajca. Na treh lokacijah smo potrdili tudi tujerodno rdečevratko in na eni rumenovratko. Na podlagi števila osebkov, starostne sestave in potrjenega razmnoževanja je populacija v zgornjem toku reke Lahinje najbolj vitalna, sledijo mrtvice Obrha pri Metliki, okolica naselja Prilozje in okolica Hrasta. V prispevku so podani tudi naravovarstveni pogledi in predlogi za razširitev omrežja NATURA 2000.

Ključne besede: želve, Emydidae, Bela krajina, Natura 2000

**Abstract. Contribution to the current distribution, ecology and conservation of the European pond turtle *Emys orbicularis* (Linnaeus, 1758) in Bela Krajina (SE Slovenia) –** Although the European pond turtle is widespread in Bela krajina according to old data, very few recent data are available on its natural history and ecology from this region. Our goal was to determine the population structure of the European pond turtle of Bela krajina and its recent distribution. To do this, we caught and marked 48 individuals in the years 2008-2012. The European pond turtle was found in native and human-made water bodies of four areas. 40% of all caught individuals were up to 10 years of age. We confirmed reproduction at five localities (Prilozje, Zjot, Golek, oxbows of the Obrh stream, Nerajec) and registered nesting sites at ponds Golek and Gornji kal. The allochthonous red-eared slider turtle and yellow-bellied slider were also present at three localities. Our results indicate that the most stable population was found in the upper reaches of the Lahinja River, followed by oxbows of the Obrh stream near Metlika, and the environs of Prilozje and Hrast villages. We additionally present our conservation views and propose the Natura 2000 network to be expanded for this species.

Key words: turtles, Emydidae, Bela krajina, Natura 2000

# Uvod

V Beli krajini se močvirska sklednica (*Emys orbicularis*) glede na obstoječe podatke pojavlja v večini UTM-kvadratov, vendar večina podatkov sega v obdobje pred letom 1996 (Krofel et al. 2009). Glede na število starih podatkov pa slednje ne preseneča. Močvirsko sklednico za Belo krajino navaja že Valvasor (1869). V svojem znamenitem pregledu favne Kranjske Freyer (1842) navaja tudi natančne lokacije - Gradac, Prilozje in reko Krupo. Zelo redko se zgodi, da je za eno vrsto z določene lokacije kar večje število starejših pisnih virov. Tako močvirsko sklednico za Prilozje omenjajo še Sajovic (1910, 1913), Deschmann (1866) in Werner (1897). Poleg Ljubljanskega barja za Belo krajino vrsto navaja tudi Krajevni leksikon Dravske banovine (Anonymous 1937).

Edino obsežnejšo raziskavo o razširjenosti močvirske sklednice v Beli krajini je napravil Hudoklin (1995). Na enem mestu je združil razpoložljive informacije, večinoma zbrane med domačini. Posledično je glede na razpoložljive podatke Tome (2003) opredelila dve območji v Beli krajini kot predlog za območje Natura 2000 za močvirsko sklednico. Leta 2004 je tako država razglasila 5 potencialnih območij Natura 2000: Dobličica (SI3000048), Gornji kal (SI3000073), Kolpa (SI3000175), Lahinja (SI3000075) in Stobe-Breg (SI3000055) (Ur. l. RS 2004a). Območje Gornji kal je bilo opredeljeno izključno zaradi močvirske sklednice. Po ugotovitvi zadostnosti predloga s strani Evropske komisije (Zagmajster & Skaberne 2006) so bila predlagana območja leta 2007 še formalno vključena v evropsko omrežje Natura 2000 (Ur. l. EU 2008). V Beli krajini so tudi tri območja opredeljena kot naravne vrednote državnega pomena kot habitat močvirske sklednice: Mestni log (8244V) - Poplavni log ob reki Kolpi pod Metliko, Prilozje – Ribnik (8246) - večja med seboj povezana ribnika zahodno od Prilozja, Bajer - ribnik pri Mlakah (4513) - zajezeno povirje potoka, ribnik pri Mlakah (Ur. l. RS 2004b).

Namen študije je bil preveriti stanje močvirske sklednice v Beli krajini, njeno razširjenost in ekologijo. Vsi dosedanji viri navajajo za Belo krajino namreč zgolj pojavljanje vrste brez informacij o ekologiji ali stanju populacij.

# Metode

## Opis območja

Za Belo krajino je značilen dinarski ravnik z nadmorskimi višinami večinoma med 100 in 200 metri ter deloma do 300 metrov nadmorske višine. Na okoliških dinarskih planotah proti zahodu in severu tekočih površinskih vod ni. Podzemne vode pridejo na plano nižje v Beli krajini v številnih tudi večjih izvirih (npr. Lahinja, Dobličica, Krupa, Jelševnik, Obrh), ki se v osrednjem delu vsi združijo v reko Lahinjo in se le-ta izlije v reko Kolpo. V nižinah ob Kolpi in v porečju Lahinje najdemo tudi slabo prepustne in neprepustne naplavine. Posledično so za povirje Lahinje značilni poplavni travniki, trstišča, nizko barje, loke in logi, tu imenovani lugi. Zaradi potreb po vodi je človek tako kot drugod na kraškem območju zgradil bazene za

zadrževanje vode (kale). Prav tako pa je številne izvire obzidal, poglobil in zagradil večinoma za namene zadrževanja vode. Bogati kraški izviri s hladno vodo so na takšnih območjih ključni vodni viri za oskrbo z vodo. Zaradi kraškega značaja pokrajine in redkih površinskih vod je bil pomen izvirov in kalov velik vse do postavitve vodovoda, ko se je njihova vloga zmanjšala, številni vodni viri so se začeli zaraščati ali so bili celo zasuti (Dražumerič et al. 1992, Perko & Orožen Adamič 1998, Plut 2008, Plut et al. 2010).

## Terensko delo

Terensko delo je potekalo med letoma 2008 in 2012 kot ciljno pregledovanje iz preteklosti znanih lokacij za močvirsko sklednico. Uporabili smo metodo opazovanja z brega, tipanje dna in lov z vršami. Pregledovali smo samo ob lepem vremenu in v času običajnih vodostajev, ko je verjetnost opažanja vrste največja. Na vseh vodnih telesih smo opravili počasni obhod. S prostim očesom in daljnogledom smo opazovali bregove in potencialna mesta za sončenje (veje, kopuče...) ter s pozornim poslušanjem poskušali odkriti osebke, ki bi se pred nami umikali s sončnih mest v vodo. Večino terenskega dela smo opravili v pomladnih mesecih in zgodnjem poletju. Najprej smo osebke locirali in po možnosti tudi ujeli. Plitvo vodo smo v visokih škornjih kar prehodili. Ob nizkih vodah smo uporabili tudi metodo »muddling« (Gibbons 1968, Meeske 2006), kar pomeni, da smo pretipali dno.

Lov z vršami je potekal zunaj časa razmnoževanja, saj se predvsem samice pred odlaganjem jajc nekaj časa ne prehranjujejo (Lukina 1966) in jih zato ni mogoče privabiti na hrano (Tab. 1). Vrše smo namestili po Vamberger in Kos (2011) na veje, drevesa in kopuče oziroma v plitvejše dele vod tako, da je ena tretjina vrše gledala iz vode, kar je preprečevalo utopitev ujete želve. Pregledovanje je potekalo vsak dan, tako da morebitni ujeti osebek v vrši ni bil več kot 24 ur. Za namene obdelave podatkov postavitev 1 vrše čez eno noč pomeni 1 lovni dan. Vse vrše so bile vedno postavljene več dni. Vsem ujetim osebkom smo določili spol in starostno skupino ter jih izmerili in označili po Vamberger in Kos (2011). Dolžino smo izmerili na 0,1 mm natančno, maso na 1 g.

V času odlaganja jajc in izleganja mladičev smo iskali gnezda. Pregledovali smo predvsem mesta ob vodnih telesih, ki so bila osončena in porasla z nižjo vegetacijo. V bližini vodnega telesa smo pregledali tudi obdelovalne površine. Sveža gnezda so prepoznavna po »čepu«, ki ga želva po odleganju jajc naredi na vrhu gnezda (Rogner 2009). Iskali smo tudi ostanke lupin izleženih mladičev oziroma izkopanih gnezd s strani predatorjev.

O uspešnem razmnoževanju sklepamo v primerih, ko smo na območju našli osebke močvirske sklednice, mlajše od 5 let. Uspešnega razmnoževanja pa ni bilo možno potrditi, če smo našli samice polne z jajci, saj je znano, da razvoj jajc lahko poteka neodvisno od parjenja (Rössler 2000, Roques et al. 2006).

**Tabela 1.** Seznam pregledanih lokacij za močvirsko sklednico (*Emys orbicularis*) v Beli krajini in vloženi lovni napor (v številu dni).
**Table 1.** List of inspected sites for the European pond turtle (*Emys orbicularis*) in Bela krajina and hunting effort (in days).

| Ime lokalitete | Št. terenskih obiskov | Št. lovnih dni (obdobje postavitve) |
|---|---|---|
| kal Krivača | 12 | 30 (28.3.-3.4.2011) |
| Gornji kal | 12 | 54 (28.3.-3.4.2011) |
| kamnolom SZ od Hrasta | 1 | |
| ribniki Prilozje | 3 | |
| ribniki S od naselja Mlake | 1 | |
| Ribnik v gozdu 800 m JZ od Prilozja | 2 | |
| Močvirje Zjot (Mlaka) | 7 | |
| Kamnolom Nerajec in kal ob kamnolomu | 2 | |
| mrtvica potoka Podturnščica 1 | 1 | |
| mrtvice potoka Podturnščica - izliv | 1 | |
| Golek – kal | 5 | |
| mrtvice potoka Obrh | 7 | 42 (22.5-24.5.2009) |
| potok Metličica - izvir | 1 | |
| Dobličica | 1 | |
| izvir Krupe | 1 | |
| potok Potok | 1 | |
| Mlaka pri Otovcu | 1 | |

## Statistična obdelava podatkov

Korelacijo med dolžino hrbtnega ščita in maso smo testirali s Pearsonovim r-testom v programskem paketu Statgraphics Plus (4.0, 1999).

# Rezultati

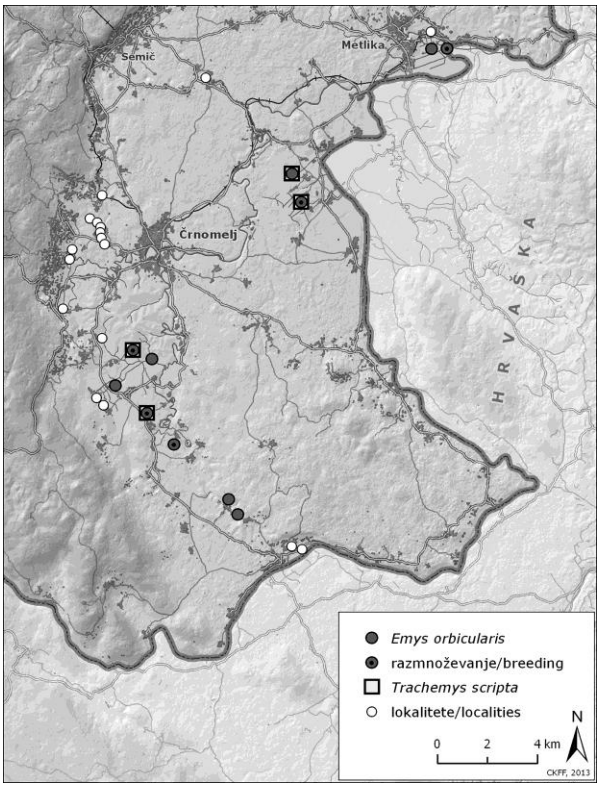
V letih 2008 do 2012 smo pregledali 17 manjših območij v Beli krajini v 58 terenskih dneh. Na 3 lokacijah so bile nastavljene vrše s skupnim lovnih naporom 126 lovnih dni (Tab. 1). Močvirsko sklednico smo potrdili na 9 lokacijah (Tab. 2, Sl. 1). Na petih lokacijah smo potrdili uspešno razmnoževanje vrste v zadnjih letih (Tab. 2).

V okviru terena smo na 3 lokacijah (ribnik Prilozje, kal Golek, kamnolom Nerajec) našli osebke tujerodne rdečevratke (*Trachemys scripta elegans*) in na eni lokaciji (kamnolom pri Nerajcu) tujerodno rumenovratko (*Trachemys scripta scripta*) (Sl. 1).

**Tabela 2.** Lokacije s potrjenim pojavljanjem močvirske sklednice (*Emys orbicularis*) v Beli krajini s številom ujetih/opazovanih osebkov (s krepkim tiskom so označene lokacije, kjer smo potrdili njeno razmnoževanje). * pomeni št. ponovno ujetih osebkov.

**Table 2.** Locations with confirmed presence of the European pond turtle (*Emys orbicularis*) in Bela krajina by the number of captured/observed specimens (locations with confirmed reproduction are marked in bold). * indicates the number of re-captured individuals.

| Ime lokalitete | Št. ujetih | Največje št. različnih osebkov |
|---|---|---|
| kal Krivača | 1 | 2 |
| Gornji kal | 2 | 3 |
| ribniki Prilozje | 1 | 2 |
| ribniki S od naselja Mlake | 1 | 1 |
| Močvirje Zjot (Mlaka) | 3 | 3 |
| Kamnolom Nerajec in kal ob kamnolomu | 7 (1*) | 6 |
| mrtvica potoka Podturnščica 1 | 1 | 1 |
| Golek - kal | 26 (3*) | 23 |
| mrtvice potoka Obrh | 10 | 10 |

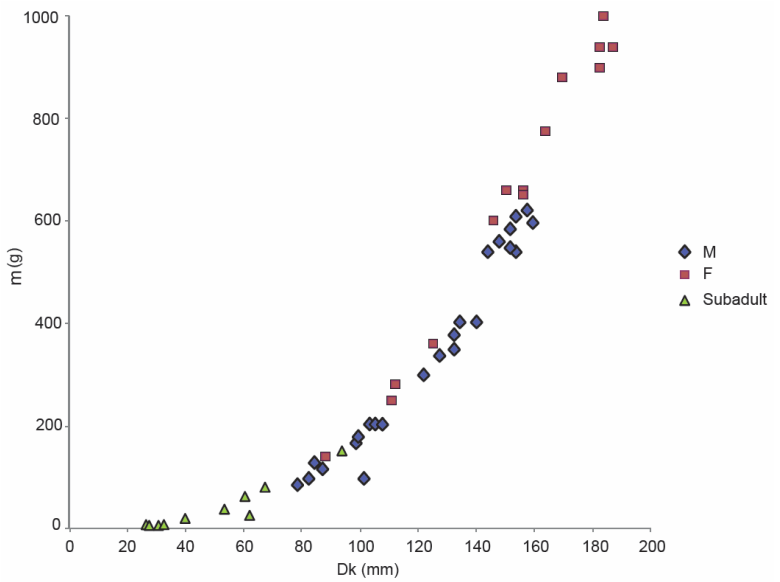



**Slika 1.** Razširjenost močvirske sklednice (*Emys orbicularis*) in popisane sklednice (*Trachemys scripta*) v Beli krajini v letih 2008-2012. Prikazane so tudi vse pregledane lokacije in lokacije potrjenega razmnoževanja močvirske sklednice v zadnjih 10 letih.

**Figure 1.** Distribution of the European pond turtles (*Emys orbicularis*) and the Pond Slider (*Trachemys scripta*) in Bela krajina in the 2008-2012 period. All checked localities and reproduction localities of the European pond turtles in the last 10 years are also shown.

### Starostna in spolna sestava populacij

Ujeli smo 48 osebkov (24 samcev, 14 samic in 10 subadultov) in na njih opravili morfometrične meritve. Korelacija med dolžino hrbtnega ščita (Dk) in maso (M) je statistično značilna (r=0,99, p<0,001, N=48) (Sl. 2). Povprečna dolžina hrbtnega ščita pri samcih je bila 123,1 mm (min–max: 78,9–159,5 mm), pri samicah 150,7 mm (min–max: 88,1–186,8 mm) in pri subadultih 49,6 mm (min–max: 26,6–93,6 mm). Povprečna masa samcev je bila 344 g (min–max: 90–620 g), samic 623 g (min–max: 280–1000 g) in subadultov 40 g (min–max: 4–150 g).




**Slika 2.** Razmerje med dolžino hrbtnega ščita (Dk) in telesno maso (m) močvirskih sklednic (*Emys orbicularis*) iz Bele krajine (48 ujetih osebkov: 24 samcev (M), 14 samic (F) in 10 subadultov).
**Figure 2.** Relation between straight-line carapace length (Dk) and body mass (m) of the European pond turtles (*Emys orbicularis*) from Bela krajina (48 caught turtles: 24 males (M), 14 females (F) and 10 subadults).

Glede na starostno sestavo največ osebkov spada v razred med 2–10 let starih osebkov (31 %). Sledijo mlajši adulti (23 %), zelo stari adulti (19 %), srednje stari adulti (17 %) in na koncu osebki do dve leti starosti (10 %).

Na kalih Gornji kal in Krivača smo ob vsakem ciljnem obisku v letu 2011 opazili vsaj en osebek močvirske sklednice. Iz števila opazovanih in ujetih osebkov lahko zaključimo, da sta se na kalu Krivača v letu 2011 zadrževala najmanj en srednje star samec in ena samica, na Gornjem kalu pa najmanj trije osebki, od tega dve samici (Tab. 2). Obe ujeti samici sta v mesecu maju imeli tudi jajca in sta sodili med starejše adulte. V preteklosti je domačin opazoval odlaganje jajc v kup peska, oddaljen manj kot 10 m od JV roba Gornjega kala.

Na kalu Golek smo ujeli 23 različnih močvirskih sklednic, od tega 6 samic, 11 samcev in 6 mladostnih osebkov. Trije osebki so bili ulovljeni po dvakrat (Tab. 2). Največ (39 %) jih je spadalo v razred od 2–10 let starih osebkov. Takoj za tem so sledili razred mladih adultov (26 %), srednje starih adultov (17 %) in na koncu stari adulti in mladiči z 8 %. Odkrili smo tudi dve mesti odlaganja jajc. Prvo leži na vzhodni strani poplavnega travnika, ki je tik ob kalu. Drugo je bilo najdeno 200 m SZ od kala na zelenici ob hiši. Pri manjšem številu subadultov (trije osebki) smo opazili anomalije oklepa (Sl. 3). En kilometer JV od vasi Golek smo v mrtvici potoka Podturnščica ujeli samico, ki je spadala med mlajše adulte.

V plitvini v vzhodnem delu kamnoloma Nerajec smo 19. 4. 2012 opazovali parjenje enega para močvirske sklednice. Ujeli smo 6 močvirskih sklednic (Tab. 2), od tega tri samce, eno samico in dva subadultna osebka. En samec je imel trnek v grlu. Starostno so bili zastopani vsi razredi, vključno z enoletnimi mladiči.

V mrtvicah Obrha smo ujeli 10 močvirskih sklednic (Tab. 2), od tega osem samcev, eno samico in enega subadulta. Hkrati smo jih lahko opazovali do 5. Na poplavnem travniku južno od mrtvice Obrha smo našli oklep močvirske sklednice s sledovi ugriza. V najstarejši razred spada 10 % vseh ujetih osebkov, mlajših adultov je 20 %, srednje starih 30 % in 40 % je osebkov, starih med 2 in 10 let. Mladičev nismo našli.

V ribniku Prilozje smo ujeli zgolj enega ravnokar izvaljenega mladiča močvirske sklednice in opazovali eno odraslo samico. V ribniku S od vasi Mlake pa smo opazovali še enega starejšega samca.

V močvirju Zjot (Mlaka) smo ujeli 3 samice močvirske sklednice. Dve sta spadali v razred mlajših adultov, ena pa v razred med 2–10 let starih želv.


**Slika 3.** Anomalije oklepa pri dveh subadultnih osebkih močvirske sklednice (*Emys orbicularis*) v kalu Golek, Bela krajina. Oznaki A in B ponazarjata različne osebke (foto: M. Vamberger).
**Figure 3.** Carapace anomalies of two subadult European pond turtles (*Emys orbicularis*) in the pond Golek, Bela krajina. Labels A and B indicate different specimens (photo: M. Vamberger).

# Diskusija

## Razširjenost

Vrsto smo potrdili na štirih območjih, kjer je bila tudi predhodno poznana (Hudoklin 1995, Tome 1996, Krofel et al. 2009), in sicer na območju potoka Obrh pri Metliki, v zgornjem toku reke Lahinje s Podturnščico, območju kala Krivača in Gornjega kala ter širšem območju Prilozja.

Na območju potoka Obrh pri Metliki smo vrsto našli v mrtvicah potoka Obrh, kjer se sodeč po starosti osebkov tudi razmnožuje . Na izviru potoka Metličica, ki je s potokom Obrh danes povezan s podzemeljsko kanalizirano strugo pod železnico, cesto in tovarno, močvirske sklednice nismo našli. Mrtvice potoka Obrh so ostanek nekoč meandrirajočega potoka, ki je bil uravnan, delov stare struge pa niso zasuli. Nekoč je močvirska sklednica verjetno poseljevala celotno poplavno območje potokov Metličica in Obrh. Danes so ohranjene mrtvice v ekstenzivni kmetijski krajini pomemben in ključen ostanek primarnega habitata vrste.

V zgornjem toku reke Lahinje smo močvirsko sklednico našli na več lokacijah (mrtvica Podturnščice, Zjot, kamnolom Nerajec, kal pri vasi Golek). Na tem območju imata reka Lahinja in Nerajčica naravno meandrirajočo strugo. Na poplavnem območju sta najbolj znana naravna rezervata Nerajske in Lahinjske luge. Bližnje nekoč poplavno območje Podturnščice in Selskega potoka je bilo sredi osemdesetih let 20 st. meliorirano, potoka pa regulirana (Dražumerič et al. 1992). Ob uravnavi struge Podturnišče so ostali deli stare struge, ki danes delujejo kot mrtvice. V eni izmed njih smo tudi potrdili močvirsko sklednico. Na tem območju je močvirska sklednica naselila tudi bližnje sekundarne habitate (kamnolom Nerajec in bližnji kal in kala pri vasi Golek). Skupaj smo tako na območju, manjšem od 10 $km^2$, potrdili 3 lokacije, kjer se močvirska sklednica še aktivno razmnožuje (Zjot, Golek, kamnolom in kal pri kamnolomu Nerajec). Zaradi novih spoznanj predvidevamo, da je verjetno to območje v Beli krajni najpomembnejše za močvirsko sklednico.

Pri vasi Prilozje smo močvirske sklednice našli v ribniku Prilozje, ki leži na robu vasi. Ribniki so razdeljeni v več delov (bazenov). Le v manjšem bazenu, ki je edini obrasel s trstičjem, smo našli mladiča in s tem potrdili uspešno razmnoževanje. V istem ribniku smo opazovali tudi odraslo samico pri sončenju. V tem ribniku smo našli tudi največ rdečevratk. Drugo odraslo močvirsko sklednico smo našli nekoliko severneje pri naselju Mlake, prav tako v mokrotni dolini z ribniki. Ribniki pri Prilozju so zelo stari, saj so vidni tudi na starih kartah Franciscejskega katastra iz let 1823 do 1869.

V okolici naselja Hrast smo močvirske sklednice našli v Gornjem kalu in kalu Krivača. V preteklih letih je bil kal Krivača suh in so ga ponovno obnovili. Kal Krivača leži na robu naselja, Gornji kal pa med hišami. Posledično so tudi motnje s strani človeka večje. Močvirske sklednice namreč kot plahe živali potrebujejo mir, še posebej v času odlaganja jajc (Wermuth 1952). Kljub vsem motnjam smo močvirsko sklednico še vedno registrirali. Sodeč po starosti najdenih osebkov se najmanj 15 let niso uspešno razmnoževale. Najverjetneje govorimo o zadnjih preživelih osebkih nekoč vitalne populacije. Oba kala sta bila zgrajena že davno in sta

vidna na starih kartah Franciscejskega katastra. Takrat je bil še ca 600 m JV od Belčjega vrha kal podobne velikosti kot Gornji kal. Območje obeh kalov leži približno na polovici 6 km dolge razdalje med reko Kolpo na jugu in izvirnim delom reke Lahinje na severovzhodu. Glede na razdalje lahko upravičeno predvidevamo, da so bili kali naseljeni po naravni poti.

Na drugih pregledanih območjih močvirske sklednice nismo potrdili. Anonymous (1937) navaja »Ne daleč od Pavičičev se proti Mlakam nahaja 'Jelenova jama', v kateri živi močvirska želva«. Danes na tem območju površinskih vod več ni, o vlažnosti območja pa priča dvolistna morska čebulica (*Scilla bifolia*). Treba pa je poudariti, da spodnjih tokov tekočih vod (Dobličica, Krupa) ter reke Lahinje in Kolpe nismo pregledovali, saj smo se osredotočili zgolj na najbolj primerna vodna telesa. Med pregledane habitate, kjer vrste nismo potrdili, spadajo zgornji tok potoka Dobličica, Jelševnik, izvir Krupe, potok Potok in mlaka pri Otovcu. Potok Dobličica je takoj pod izvirom manj primeren za močvirsko sklednico, saj so brežine dokaj strme, v vodi pa ni nobenih podrtih dreves, na katerih bi se lahko močvirske sklednice sončile. Izvir Krupe je po našem mnenju tudi manj primeren, saj ob njem v zadnjih letih spodbujajo turistični razvoj, hkrati pa je voda na izviru mrzla in tako manj primerna. Podobno lahko zaključimo za širše območje v izvirnem delu potoka Potok, saj je le-ta pod izvirom dokaj mrzel in hitro tekoč. Vsekakor pa je poleg tega možno, da smo vrsto kje spregledali.

## Habitat

Za močvirsko sklednico v Beli krajini so pomembne stare struge potokov, poplavne doline in druge stoječe vode. To so tudi njeni primarni habitati (Jabłoński 1998, Drobenkov 1999, Fritz 2003). Predvidevamo, da so sekundarne habitate (kali pri naselju Hrast in Golek, kamnolom Nerajec) močvirske sklednice kolonizirale same, saj je znano, da imajo zelo dobro razvit čut za orientacijo, ki jih vodi do vodnih površin (Kistjakowski & Smogoržewskij 1973). Poleg tega močvirske sklednice lahko dnevno prehodijo daljše razdalje. Povprečje na dan za samico je 36 m, za samce 86 m in za mladostne osebke celo 54 m (Servan 1987). Študija iz Drage pri Igu je pokazala, da je domači okoliš samca znašal 11,86 ha, samice pa 6,56 ha (Vamberger & Kos 2011). Seveda pa ni izključeno, da jih je tja prinesel človek iz bližnjih naravnih habitatov.

Danes primarni habitati, naravni meandrirajoči nižinski potoki, izginjajo in so ohranjeni le še fragmentarno kot posamezni odseki nekdanjih strug. V novih reguliranih vodah je tok hiter in strme brežine neprimerne za močvirsko sklednico. Habitati s hitro tekočo vodo, nižjimi temperaturami in strmimi brežinami so neprimerni zaradi prevelike energijske porabe želv (Rogner 2009). V preteklosti je verjetno poseljevala tudi povirna območja z bogato močvirsko floro, kjer se je voda razlivala in mezela. Danes neposredna okolica manjših izvirov več ne predstavlja naravnih habitatov, saj je večina teh izvirov zajezena, obzidana in poglobljena, struge pa so speljane v ozkem kanalu. Strukturiranost z globokimi in plitvimi deli je izginila in s tem tudi pestrost življenjskih okolij.

## Spolna in starostna struktura

Na podlagi starostne in spolne sestave ocenjujemo populacijo močvirske sklednice v Beli krajini kot vitalno. Med želve, stare do deset let, spada okrog 40 % osebkov. V primerjavi z edino populacijsko študijo v Sloveniji iz doline Drage pri Igu (Vamberger & Kos 2011) smo našli precej več subadultnih in juvenilnih osebkov. Delež zelo starih odraslih pa je manjši. Tudi študije iz drugih držav pričajo o manjšem deležu juvenilnih in subadultnih osebkov (Litva: 23 % (Meeske 2006), Brenne: 31 % (Servan 1988, 1998), Italija, Padova: 19 % (Mazzotti 1995)) in precej večjem deležu zelo starih adultov (Meeske 2006). Hkrati se zavedamo, da na oceno o vitalnosti populacije v Beli krajini vpliva predvsem manjše območje (kal Golek), kjer smo našli skoraj polovico vseh ulovljenih osebkov (48 %). Večje število (13 %) smo ujeli tudi v kamnolomu in kalu Nerajec in v mrtvici Obrha (21 %). Drugje smo zabeležili zgolj posamezne osebke. Prav ta območja z večjim številom osebkov, starostno sestavo v obliki piramide in s potrjenim razmnoževanjem spadajo med najbolj pomembne dele vitalne populacije v Beli krajini. Na drugih območjih o vitalnosti ne moremo govoriti.

Spolna sestava ulovljenih osebkov v Beli krajini je 1:1,72 v prid samcev. Podobno razmerje so zabeležili tudi v južnih območjih razširjenosti močvirske sklednice (Malorka: 1:1,3 (Pieh & Sättele 1998); srednja Italija: 1:1,75 (Rovero & Chelazzi 1996); južna Francija: 1:1,67 (Devaux & Bley 1998)).

Podobno kot na Dragi pri Igu (Vamberger & Kos 2011) so bile odrasle samice večje od samcev. Znotraj posameznih skupin nam je uspelo ujeti tudi manjše osebke, kot so bili ujeti na Dragi (Vamberger & Kos 2011).

Na petih območjih smo potrdili razmnoževanje in prav ta območja so ključna za ohranjanje vrste. Velja omeniti, da morda razmnoževanja na drugih območjih zgolj nismo opazili in kljub temu obstaja, saj je na večini lokacij dovolj odraslih osebkov. Poleg tega smo potrdili, da se tudi v Beli krajini močvirske sklednice parijo takoj po hibernaciji, kar je v tem primeru aprila, enako kot v ribnikih Drage pri Igu (Vamberger & Kos 2011).

Anomalije oklepa subadultnih osebkov iz kala Golek so lahko kazalec suboptimalnih temperatur med inkubacijo (ii), parjenja v sorodstvu (ii) ali negativnih efektov kemikalij zaradi intenzivne kmetijske rabe okolice (iii) (Fernández in Rivera 2004).

## Varstvo

Na ozemlju Slovenije je močvirska sklednica zavarovana že od leta 1921 po predlogu za zavarovanje iz leta 1920 v Spomenici (Spomenica 1920). Danes so osebki močvirske sklednice in vsi njeni habitati zavarovani (Ur. l. RS 2004c) ne glede na vključitev v prostorsko opredeljena območja varstva narave. Tako je največja prednost prostorsko opredeljenih varovanih območij (npr. območij Natura 2000) predvsem pri pridobivanju sredstev za obnovo habitatov in upravičenosti do nadomestil za spremembo gospodarjenja z namenom ohranjanja ali izboljšanja habitatov.

V Beli krajini trenutno prostorsko varovanje habitatov močvirske sklednice delno pokrivajo območja Natura 2000, krajinski parki in naravne vrednote (NV). Najdišča močvirske sklednice pokrivajo tudi NV, za katere vrsta ni posebej navedena (npr. Gornji kal, Zjot in Podturnščica), zato bi bilo smiselno tudi za te NV opredeliti močvirsko sklednico kot eno izmed ključnih vrst. Glede na redkost vrste pa bi bilo najboljše kar vsa najdišča opredeliti kot naravne vrednote, vsekakor pa mesta, kjer se dokazano razmnožuje (npr. Golek). Krajinski park Lahinja prostorsko pokriva močvirje Zjot (Mlaka). Reke Kolpe sicer nismo vzorčili, po naših podatkih pa v Krajinskem parku Kolpa za zdaj ni znanih podatkov o močvirski sklednici. Glede na nove podatke, predstavljene v tej študiji, bi bila smiselna tudi razširitev omrežja Natura 2000. Rezultati biogeografskega seminarja sicer zaključujejo, da je pokritost močvirske sklednice zadostna (Zagmajster & Skaberne 2006), vendar temeljijo zgolj na razširjenosti vrste in starih podatkih. Novi podatki o velikosti populacije in lokacijah razmnoževanja (Golek, kamnolom Nerajec) kažejo, da najbolj pomembna območja (Golek, kamnolom pri Nerajcu) niso vključena v omrežje Natura 2000. Večina teh območij je bila opredeljena predvsem z vidika vodnega dela habitata. Če upoštevamo samo v tej študiji potrjena najdišča vrste, se prekriva 100 m pufrski pas okrog vodnih habitatov samo v 24,4 ha z Natura 2000 (od skupaj 41,8 ha), v pufrskem pasu 1 km pa je le 6,5 $km^2$ v območju Natura 2000 (od 28,2 $km^2$). Problem delnega varstva vrste je tudi meja tistih varovanih območij, ki zajemajo samo vodni habitat oziroma le ozek pas vegetacije ob njem. Zato je z vidika varovanja habitata vrste močvirska sklednica zaradi specifične ekologije precej velik naravovarstveni izziv. Najlaže jo odkrijemo in opazujemo v vodnem delu habitata, enako pomemben pa je tudi kopenski del, kjer odlaga jajca. Pri varovanju vrste in njenega habitata je zato ključno poznavanje mest odlaganja jajc. Jajca lahko odlagajo v neposredni bližini vode (Zuffi 2000), do 1 km (Zuffi 2000), 1,2 km (Schneeweiss et al. 1998) ali celo do 5 km stran od vode (Fritz in Günter 1996, Jabłoński in Jabłońska 1998). Ficetola et al. (2004) predlagajo za vzdrževanje ugodnega stanja populacije varovanje kopenskega okolja vsaj 1–1,5 km okoli voda. Ožji kopenski pas je pomemben za dnevne premike (i), odlaganje jajc (ii) in prehranjevanje (iii). Z navidez »nedolžnimi« posegi stran od vode lahko močno vplivamo na vrsto. Poleg poznavanja mest odlaganja jajc, ki so lahko tudi na intenzivnih kmetijskih površinah, je enako pomembno poznavanje lokalne ekologije vrste, predvsem časa izleganja mladičev. Mladiči se ob zadostni toploti lahko izlegajo pozno poleti (konec avgusta, septembra) (Fritz 2001). V letih, ko poletja niso dovolj topla za potek popolnega razvoja, del mladičev lahko prezimi v jajcu in zleze ven šele naslednjo pomlad (Fritz 2001). V primeru, da je močvirska sklednica odložila jajca na njivo, oranje pred izleženjem mladičev pomeni tudi uničenje celotnega zaroda. Za vrsto je znano, da odlaga jajca na stalna mesta (Wermuth 1952). Zato obstaja verjetnost, da že od nekdaj odlaga jajca na določene njive, na katerih pa se je v zadnjih desetletjih, če ne drugega, spremenila tehnologija obdelave iz živalske vprege v strojno, ki ima za posledico vsaj globino oranja. Ravno za rešitev takšnih lokalnih problemov je ključno poznavanje lokalne specifične ekologije. Ponoči se močvirska sklednica lahko prehranjuje tudi na kopnem z žuželkami in mehkužci (Ficetola & De Bernardi 2006). Razdalje med 2,3 in 4 km na kopnem od vodne površine pa niso redkost (Ficetola & De Bernardi 2006). V sušnih poletjih na kopnem tudi estivirajo (Ficetola & De Bernardi 2006). Zato bi morali v prihodnosti s pomočjo terenskih raziskovanj nujno definirati tudi okoliška območja, ki so poleg primernosti vodnega habitata in brežine ključna za dolgoročno preživetje vrste.

Prostorska opredelitev v pravnih dokumentih je le en izmed prvih korakov za doseganje cilja – ohranjanja vitalne populacije močvirske sklednice in njenega habitata v ugodnem ohranitvenem stanju v Beli krajini. Preseneča dejstvo, da dejavnosti niti na območjih, ki so bila opredeljena za varstvo močvirske sklednice, niso podrejene njenemu varovanju. Vsa območja z močvirsko sklednico bi bilo smiselno začasno popolno izvzeti iz ribiškega upravljanja (Prilozje, kamnolom pri Velikem Nerajcu). V ribolovnih ribnikih je ribolov lahko usoden za 20 % močvirskih sklednic (Nemoz et al. 2004). Dokaz za možen negativen vpliv ribolova v Beli krajini je tudi ujeti samec s trnkom v grlu iz kamnoloma Nerajec (osebku je bil trnek odstranjen). Zaradi plenjena komaj izleglih mladičev želv (Fritz 2003) bi bilo treba odstraniti plenilske vrste rib (npr. somi, ščuke). Za varovanje vrste je predvsem pomembno zmanjšati človekov vpliv, ne samo uničevanje habitata, temveč tudi njegovo prisotnost (Cadi & Joly 2000, Fritz 2003). To seveda ne pomeni, da je treba človeka izriniti iz okolja, ki si ga deli z močvirsko sklednico. Vpliv se lahko močno zmanjša z gosto obrežno vegetacijo in drugimi ukrepi. Vsekakor pa se na lokacijah, kjer se močvirske sklednice razmnožujejo, ne sme spodbujati večjega obiska, kaj šele razvijati turizem. V vodnem delu habitata pa bo v prihodnosti treba tudi spremljati vpliv tujerodnih vrst želv, ki do te študije v Beli krajini še niso bile poznane (Krofel et al. 2009). Glede na klimo bi se lahko v Beli krajini celo razmnoževale, kot je bilo potrjeno na nekaterih drugih lokacijah v Sloveniji (Vamberger et al. 2012). Eden izmed negativnih vplivov, ki bi se lahko v Beli krajini izrazil predvsem v majhnih vodnih habitatih, je vpliv tekmovanja za mesta sončenja. Na manjših vodah je lahko mnogo večji kot na vodah večjega obsega.

Kljub razmnoževanju na kar nekaj lokacijah v Beli krajini in oceni, da je vsaj del populacije vitalen, pa pozitivne ocene ne moremo podati za stanje habitata. Ocenjujemo, da trenutno habitat močvirske sklednice ni v ugodnem ohranitvenem stanju, saj je človekov vpliv skoraj na vseh lokacijah vodnega dela habitata prevelik. Zato bi bilo vsaj na nekaterih lokacijah ključno izboljšanje kvalitete vsaj vodnega dela habitata, na nekaterih lokacijah pa njegova obnova. O rabi kopenskega habitata imamo premalo podatkov in bi bile za podrobnejše smernice ohranjanja tega dela habitata nujne dodatne usmerjene raziskave. Z vidika ohranjanja mreže povezanih vodnih in kopenskih habitatov (Fritz 2003) bi bilo v Beli krajini smiselno poleg suhih starih mrtvic (Obrh, Podturnščica) obnoviti tudi meandre in nekdanje kale kot aktivni ukrep za izboljšanje habitata številnim vrstam, ne samo močvirski sklednici. Predvidevamo, da v Beli krajini sicer vitalna populacija v prihodnosti brez aktivnih ukrepov ohranjanja in izboljšanja habitata dolgoročno ne bo preživela. Razveseljivo pa je, da se vrsta trenutno še razmnožuje v Beli krajini in zato uresničitev predlaganih ohranitvenih ukrepov verjetno še ne bi bila prepozna.

# Summary

Between 2008 and 2012, we determined the population structure and distribution of the European pond turtle of Bela krajina. Our results revealed that the turtle's most important habitats are old streams, natural fluted valleys and standing water bodies. Streams and rivers between the water bodies act as important corridors for migrations. On the other hand, cold stream sources or fast flowing streams are less suitable habitats. The population of *Emys orbicularis* is stable in Golek and Nerajec, where we caught more than 50% of all individuals. All other were single findings. Forty percent of all caught individuals were up to 10 years old. A male-biased sex ratio was recorded. We confirmed reproduction at five localities and registered nesting sites at Golek and Gornji kal ponds. Our results indicate the most stable population in the upper reaches of the Lahinja River, followed by oxbows of the Obrh stream near Metlika, and the environs of Prilozje and Hrast villages. The allochthonous red-eared slider turtle and yellow-bellied slider were also present at three localities.

Based on the recent distribution data and ecology of the species, expansion of the Natura 2000 network should be considered. The most important localities for the terrapins in Bela krajina are not within the framework of Natura 2000 network. Moreover, until now the importance of terrestrial habitats has been overlooked, since only aquatic habitats are protected under Natura 2000. Nevertheless, terrestrial habitats as important reproduction and feeding areas are essential for the populations' long-term survival. Intensification of agriculture in the terrestrial habitats surrounding water bodies and fishing in these water bodies should be prevented. Conservation plans for *E. orbicularis* should include protection of extensive terrestrial habitats with a system of different aquatic water bodies, monitoring of impact of non-native turtles, and reduction of human impact on the habitat. We assume that a long-term survival of the turtle in Bela krajina is less likely without these active conservation plans.



# Zahvala

Terenske raziskave so potekale v skladu s pristojnostmi na podlagi dovoljenja za ujetje, vznemirjanje in odvzem zavarovanih vrst, ki ga je Agencija RS za okolje izdala Centru za kartografijo favne in flore pod šifro 35601-35/2010-6 z dnem 27.5.2010 in Društvu za preučevanje dvoživk in plazilcev (Societas Herpetologica Slovenica) šifra 35601-60/2005-4 z dnem 21.6.2006 in šifra 35601-47/2011-6 z dnem 21.4.2011. Del terenskega dela je bil financiran v okviru projekta »Inventarizacija flore in favne vodnih virov na območju občin Črnomelj, Metlika in Semič (VIRI ŽIVLJENJA (OP IPA SI-HR 2007-2013))« in »Popis začetnega stanja in preučevanje vpliva projektnih aktivnosti na populacije močvirske sklednice (*Emys orbicularis*) na projektnem pilotnem območju Gornji kal (kal Hrast in kal Krivača) (WETMAN (LIFE 09NAT/SI/000374))«, ki ju je opravljal Center za kartografijo favne in flore po naročilu Zavoda Republike Slovenije za varstvo narave, in v okviru presoje o stanju kvalifikacijske vrste močvirska sklednica (*Emys orbicularis*) na območju Natura 2000 Metlika, kar je bilo zaupano prvi avtorici po naročilu Ipsum, okoljske investicije d.o.o. Posebna zahvala velja Matjažu Gregoriču za pomoč pri terenskem delu 2008 ter Maji Sopotnik in Branki Trčak, ki sta pri svojem terenskem delu ulovili želve.

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NATURA SLOVENIAE 15(2): 39-50
SCIENTIFIC PAPER

Prejeto / Received: 15.7.2013
Sprejeto / Accepted: 24.10.2013

# Is the parti-coloured bat *Vespertilio murinus* Linnaeus, 1758 a common bat species in Slovenia?

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**Abstract.** In the last overview of bats in Slovenia, the parti-coloured bat *Vespertilio murinus* was one of the rarest species listed. However, in the past few years (June 2005 - April 2013) we have found 98 new locations. In this article, we present new data on mating sites, summer roosts and hibernacula, as well as other chance encounters. Although *V. murinus* is a permanent part of the bat fauna in Slovenia, it is much more evident during the colder part of the year, when migrating individuals possibly reach their wintering area. We argue that this bat species is much more common in Slovenia and its neighbouring regions than previously assumed.

Key words: *Vespertilio murinus*, mating sites, summer roosts, hibernacula, chance encounters, Slovenia

**Izvleček. Ali je dvobarvni netopir *Vespertilio murinus* Linnaeus, 1758 pogost v Sloveniji? –** V zadnjem pregledu netopirjev v Sloveniji je bil dvobarvni netopir (*Vespertilio murinus*) zabeležen kot ena najredkeje opaženih vrst netopirjev. V zadnjih letih (junij 2005 – april 2013) pa smo s terenskimi raziskavami odkrili 98 novih najdišč. V prispevku podajamo nova opažanja parišč, poletnih zatočišč in prezimovališč ter drugih naključnih najdb. Dvobarvni netopir se v združbi netopirjev v Sloveniji pojavlja stalno, vendar je laže opazovan v mrzlem delu leta, ko živali verjetno priletijo k nam na prezimovanje. Zato menimo, da je ta vrsta netopirja tako v Sloveniji kot v sosednih pokrajinah precej bolj pogosta, kot smo sprva predvidevali.

Ključne besede: *Vespertilio murinus*, parišča, poletna zatočišča, prezimovališča, naključne najdbe, Slovenija

# Introduction

The established range of *Vespertilio murinus* in Europe stretches from the Pyrenees Mountains, over central Europe to the south of Scandinavia, and towards Russia. Records south of the Alps are rare; the species, however, has been found in the northern part of Italy, Slovenia and throughout the Balkan Peninsula as far as northern Greece (Baagøe 1999, Dietz et al. 2009, Alberdi et al. 2012). In the latest overview of bats in Slovenia (records dating until mid 2005), Zagmajster (2009) reported only on 12 *V. murinus* sites (13 encounters). On almost one half of these sites (five), male display calls were heard, exact locations established for two males and two females, and three chance encounters made, where sex of the animals was not recorded. Without any exact roost being known, this bat was ranked among the four rarest out of the 28 bat species living in Slovenia (Presetnik et al. 2009a).

In recent years, we regularly heard display calls of *V. murinus* during ultrasound transect monitoring (Presetnik et al. 2007, 2009b, 2011, 2012), which encouraged additional research to locate their mating sites. Ultrasound field observations, along with a few discoveries of summer roosts (e.g. Žibrat 2005, Petrinjak 2010) and hibernacula, as well as additional records of chance encounters of mainly injured or exhausted bats, gave a significantly different picture of the species' distribution and frequency of occurrence in Slovenia, which we present in this paper.

# Material and methods

## Ultrasound inventarisation

During the establishment of the national bat monitoring scheme, several foot transect counts using ultrasound detectors were selected (Presetnik et al. 2007, Presetnik & Podgorelec 2008). Among them, a transect near the hamlet of Leskova dolina in the southern part of Slovenia close to Mount Snežnik (at approximately 850 m a. s. l.) was selected, with the main purpose being monitoring of *V. murinus*, since we had previously heard the bat's characteristic echolocation calls (Schaub & Schnitzler 2007) and social calls (Ahlén & Baagøe 1999) there. On this particular transect, we repeated field observations of *V. murinus* in almost each consecutive autumn, which prompted additional ultrasound inventarisation, a pilot study in 2009, and more intensive research in 2011 and 2012. The method used was slow driving by car (approximately 20 km/h) while listening with unaided ears for the bat's social calls, and with an ultrasound detector (Pettersson D240x) for its echolocation calls. We recorded all bat calls with a digital recorder (Marantz PMD 670) and later analysed the data with the BatSound 4.0 program (Pettersson Elektronik). Firstly, we selected transects in the vicinity of *V. murinus* known locations (Presetnik et al. 2009a), then in similar environments in some other parts of Slovenia, including the capital city of Ljubljana. Most transects were carried out in October and one in November, and they usually started approximately 1–1.5 hours after sunset and lasted, with one exception, for less than 3 hours. Additionally, we also recorded some advertisement or echolocation calls of *V. murinus* on a few other occasions.

### Roosts and chance encounters

During the period between mid 2005 and mid April 2013, many members of the public informed the SDPVN – Slovenian Association for Bat Research and Conservation on finds of injured, exhausted or strayed bats (e.g. Podgorelec 2011), which we will address as »chance encounters«, or on sightings of groups of bat in various environments, and when we checked these finds, some turned out to be *V. murinus*. If possible, we measured the bat's mass (0.5 g accuracy), the length of its forearm (0.1 mm accuracy), and determined its sex and reproduction status.

## Results

### Autumn ultrasound inventarisation and other ultrasound observations

During the national monitoring ultrasound surveys on the »Leskova Dolina« transect, we heard advertisement calls of *V. murinus* in five out of six autumn counts, and echolocation calls during one out of six summer counts (App. 1). During nine car transect surveys, we covered slightly over 500 km (Tab. 1, Fig. 1); we recorded *V. murinus* on 59 occasions (57 new locations and two repeated locations) and heard social calls on 43 of them (App. 1). The number of locations per car transect ranged from zero (three transects) to 21 (Tab. 1). On six transects with *V. murinus* recorded, the average number of recordings per kilometre was 0.21 (range: 0.09–0.39). On car transects, 76% of bat observations concerned *V. murinus.* During other ultrasound transect surveys conducted on foot and during other field inventarisations, we recorded *V. murinus* on 21 occasions in 14 locations, and heard social calls 15 times (Fig. 1, App. 1).

Altogether, we heard *V. murinus* on 86 occasions in 72 new locations and once in a previously known location (Fig. 1, App. 1). The locations ranged from between 150 to 1,100 m a. s. l. The bats were predominantly observed in small and large settlements with at least one street light (39.7% of locations), though most observations occurred on the edge of a settlement, where lights were not present or illumination was dim, and a forest edge was close by. Smaller settlements – hamlets without street illumination, usually located in forest clearings or close to forest edges – accounted for 19.2% of locations. Locations on forest edges (e.g. roads in forests) accounted for 17.8% of locations, forest clearings that contained a building (e.g. forester's hut, hunting hut or some other sort of building) accounted for 16.4% locations; a further 5.5% of locations were in forest clearings without any building, while one location (1.4%) was on the bank of a large river.

**Table 1.** Car transects and number of *Vespertilio murinus* locations found. For exact locations, see App. 1, Fig. 1.
**Tabela 1.** Avtomobilski transekti in število najdišč dvobarvnega netopirja (*Vespertilio murinus*). Natančna mesta najdb so navedena v Dod. 1 in prikazana na Sl. 1.

| **Transect (length)**<br>**Transekt (dolžina)** | **Date**<br>**Datum** | **No. locations (range of height a. s. l.)**<br>**Št. najdišč (razpon nadmorskih višin)** | **No. loc./km**<br>**Št. najdišč/km** |
|---|---|---|---|
| Car transect A – »Javorniki 1« (10.8 km) | 6.10.2009 | 2 (587–826 m) | 0.18 |
| Car transect B – »Javorniki 2« (55.1 km) | 1.10.2011 | 15 (587–1096 m) | 0.27 |
| Car transect C – »Krim - Rakitna« (64.4 km) | 3.10.2011 | 0 | 0.00 |
| Car transect D – »Goteniška gora« (77.3 km) | 4.10.2011 | 7 (746–1043 m) | 0.09 |
| Car transect E – »Banja Loka – Kočevski Rog« (85.7 km) | 5.10.2011 | 0 | 0.00 |
| Car transect F – »Ljubljana« (34.9 km) | 6.11.2011 | 6 (288–314 m) | 0.17 |
| Car transect G – »Črni vrh – Vrhnika« (54.0 km) | 16.10.2012 | 21 (585–734 m) | 0.39 |
| Car transect H – »Bloška planota – Rakitna« (65.5 km) | 17.10.2012 | 8 (678–845 m) | 0.12 |
| Car transect I – »Dvor – Kočevska mala gora« (55.7 km) | 23.10.2012 | 0 | 0.00 |

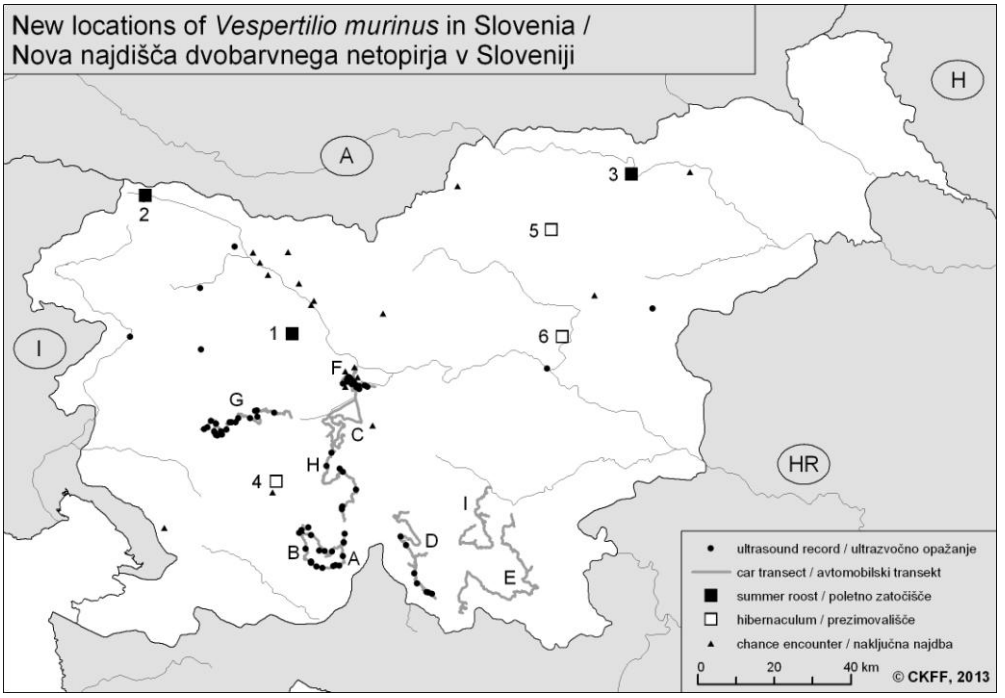


**Figure 1.** New locations – roosts, detector surveys and chance encounters of *Vespertilio murinus* in Slovenia (June 2005 – April 2013). Roosts 1–6 are described in subchapter b of Results; for details on car transects A–I, see App. 1.
**Slika 1.** Nova najdišča – zatočišča, ultrazvočna in naključna opažanja dvobarvnega netopirja (*Vespertilio murinus*) v Sloveniji (junij 2005 – april 2013). Zatočišča 1–6 so opisana v podpoglavju b poglavja rezultati; za podrobnosti o avtomobilskih transektih A–I glej Dod. 1.

## Records of summer roosts and hibernacula

On 6. 6. 2009, the owners of the Mini Hotel in the village of Vincarje near Škofja Loka (Fig. 1, location 1) noticed many bats emerging in the evening from behind the outer wooden panelling of a two-storey building. On 10. 6., 47 bats emerged, while on 14. 6., at least 50 were recorded, and since all three caught bats were adult *V. murinus* males (App. 2), we apparently observed an exclusively male group. The summer roost of the second male group was located behind a closet standing on the balcony of the fourth floor of a block of flats (Bezje 4) in the village of Kranjska Gora (Fig. 1, location 2) and was observed on 19. 7. 2010 (Petrinjak 2010). The colony consisted of 11 animals and from the 10 measured all were males (App. 2). Another summer observation (1. 8. 2005) was reported by Presetnik (2007) from the attic of the Fala Mansion (Fig. 1, location 3), where an unsexed individual was hanging close to the apex of the roof.

On 15. 2. 2011, a hibernaculum of *V. murinus* was discovered in the entrance section of the cave known as Planinska jama (Fig. 1, location 4), as four bats (two adult males, App. 2) were found to be hiding separately in shallow crevices among more than a hundred *Pipistrellus pipistrellus*, at temperatures between 4.4–4.9 °C. We found another adult male in a crevice approximately 3 m above the ground and 30 m from the entrance of the cave Huda luknja near Gornji Dolič on 9. 2. 2013 at 2.0 °C (Fig. 1, location 5, App. 2). Another bat of unknown sex was hibernating in a warehouse in the village of Spodnja Rečica near Laško (Fig. 1, location 6) on 22. 1. 2013, where discovered upon the shifting of a piece of warehouse equipment.

## Chance encounters

From mid 2005 until mid April 2013, 20 other observations of *V. murinus* were made (Fig. 1). In App. 2 we list details on them, together with details about three animals, the locations of which and dates of their discovery have already been given by Presetnik et al. (2009a). Altogether, out of 18 animals examined by experienced chiropterologists, 13 were males and five females (one nulliparous, three adult and one female whose reproductive status was not assessed). One third of animals were found in December and January, while the second numerical spike was registered in April, when almost one quarter of animals were found. We recorded no injured, exhausted or strayed *V. murinus* in the June–September period (Fig. 2, App. 2).

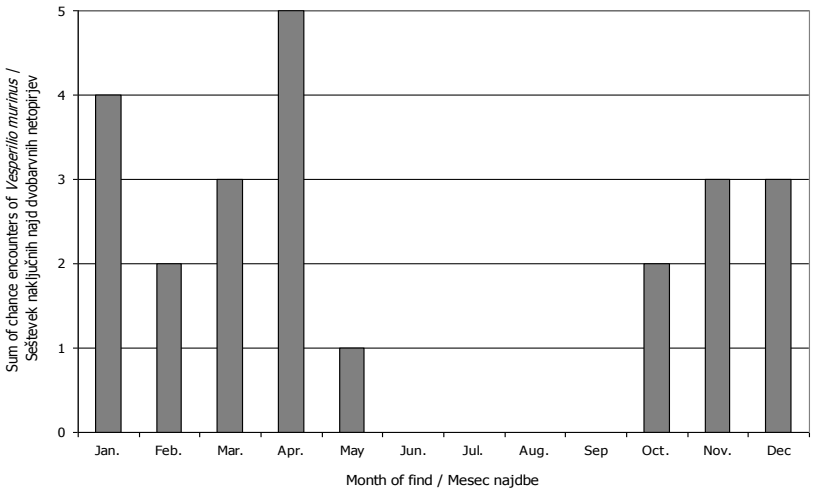


**Figure 2.** Sum of chance encounters – injured, exhausted or strayed *Vespertilio murinus* with regard to the month of find (October 2002 – April 2013).
**Slika 2.** Seštevek naključnih najdb – poškodovanih, oslabelih oz. zablodelih dvobarvnih netopirjev (*Vespertilio murinus*) glede na mesec najdbe (oktober 2002 – april 2013).

# Discussion

We have documented records of *Vespertilio murinus* at 98 new locations in Slovenia (72 ultrasound observations, 6 roosts, 20 chance encounters; Fig. 1), which is an 8-fold increase in the number of locations for this species in comparison to Zagmajster (2009). However, the change in research methodology had contributed to the sharp increase in the number of locations found. Before our study, autumn ultrasound surveys with adequate equipment were extremely rare, but interestingly, if they were performed, *V. murinus* was quickly found (Zagmajster 2003). Autumn ultrasound surveys also had an advantage over summer counts, since in autumn, male *V. murinus* often performed unmistakable display songs. The rarity of ultrasound finds during the summer period (foot surveys Leskova dolina, Most na Soči, Kranjska Gora; App. 1) could be a consequence of a) possibly smaller summer population of *V. murinus*, and/or b) the difficulties to exactly determine their echolocation calls, which can be easily confused with other species (e.g. *Nyctalus noctula*, *N. leisleri*, *Eptesicus serotinus* (Ahlén 1990)). In any case, our autumn inventarisation revealed that *V. murinus* is, at least in some areas, very common. In fact, during our October and November inventarisations, it was the most frequently recorded species, but as the extent of research was limited, additional research would be necessary to make conclusions as to the abundance of specific bat species.

It is unclear why we frequently heard *V. murinus* along some car transects and did not record it at all along others, but it could possibly be connected with the weather conditions in which our field research was performed. At least on the evening of »car transect I« (Tab. 1, Fig. 1), when we did not hear *V. murinus*, the weather changed from high pressure and clear skies of the previous days to low pressure with low cloud cover and heavy fog.

Obviously the same areas were possibly used by *V. murinus* as mating sites over a span of several years, given that we regularly recorded it in different years at the end of the »Leskova dolina« foot transect in the hamlet of Leskova dolina itself (App. 1), as well as on both occasions when we surveyed the hamlet of Šranga (car transects A and B, App. 1). Another sign of site fidelity are the observations of display songs at the forest clearing along the forester's hut at Medvedjek (car transect D), where display songs had actually been observed 11 years earlier (Zagmajster 2003). The apparent mating site fidelity by *V. murinus* and the easy determination of the species' social calls could be used in the future as a way for its long term monitoring, since Slovenia's current bat monitoring system cannot provide information on population trends for this species (Presetnik et al. 2011, 2012).

Records regarding the two summer colonies, together with the observation of an individual in the Fala Mansion and the summer ultrasound observations (App. 1, 2) are strong evidence that a permanent population of *V. murinus* exists in Slovenia. For now, it seems that the summer population is composed mainly of males, since only one observation of a gravid female has been made in the night between 3. and 4. 6. 1994 (Kryštufek & Červeny 1997). We have to note that in the area of Kočevski Rog, where this gravid female bat was found, almost no additional inventarisation was made in a similar period, but perhaps this female was late on its migratory journey towards its maternity area in the north. This assumption is based on the fact that all the closest confirmed maternity colonies of *V. murinus* are situated in the western part of Switzerland, the southern part of Bavaria and the Czech Republic, and that the centre of its maternity area is even further towards NE Europe and Russia, where maternity colonies are formed from May to August (Baagøe 2001). It seems that the situation in Slovenia is similar to the situation in neighbouring Austria, where only male groups or non-reproductive females have been observed during summer (Spitzenberger & Bauer 2001, Guido Reiter in litt.).

The finds of *V. murinus* hibernating in fissures in caves are also interesting, as they point out at possible natural winter roosts in rock walls. In caves, *V. murinus* is not usually seen (Rydell & Baagøe 1994), though Hanák et al. (2010) give accounts of bone deposits in rocky fissures covering the period from the late Pleistocene to recent times. The rarity of observations in caves and cliffs could be related to the difficulty of discovering bats hibernating in narrow crevices. In general, the reported observations in Europe show *V. murinus* hibernating in buildings, where it is usually discovered during their renovation or shifting of a piece of equipment (Rydell & Baagøe 1994), as was also the case in the warehouse in Spodnja Rečica. Additional hibernacula were probably also close to some locations where we noted injured, exhausted or stray bats (App. 2). Dates of these finds are concentrated in the autumn through the winter to mid-spring period and not during the time when pups are born (late June, early July; Baagøe 2001). This suggests that Slovenia is used by male and female *V. murinus* as a wintering area (finds in December–February) and probably also as an area for its seasonal migration (finds in March–May and October–November). Although not a single out of 8 *V. murinus* banded in Slovenia has been recovered, possible vagrant parts of the population probably migrate toward the NE of Europe as suggested by band recoveries in neighbouring Austria (Hutterer et al. 2005).

Our research confirmed that *V. murinus* is a permanent part of the fauna in Slovenia, though it is much more conspicuous during the colder part of the year; possibly also because of seasonal migrations. We expect that some additional autumn research would quickly reveal its presence in most areas of Slovenia and, of course, in its neighbouring regions.

# Povzetek

Dvobarvni netopir (*Vespertilio murinus*) je bil z manj kot 15 mesti opažanj v zadnjem pregledu netopirjev (Presetnik et al. 2009a, Zagmajster 2009) med najredkeje najdenimi vrstami v Sloveniji. Vendar so raziskave v okviru monitoringa netopirjev potrdile redno jesensko pojavljanje dvobarvnega netopirja v Leskovi dolini (Snežnik). To je spodbudilo dodatne raziskave, ki so hitro prinesle kopico novih najdb. Osnovna metoda je bil oktobrski in novembrski popis netopirjev z ultrazvočnimi detektorji, ki se je začel približno 1–1,5 ure po sončnem zahodu in je z eno izjemo trajal manj kot 3 ure na noč. Ob vožnji z avtomobilom (približno 20 km/h) smo s prostim ušesom poslušali značilne svatbene napeve dvobarvnih netopirjev in hkrati z ultrazvočnim detektorjem (Pettersson D240x) in digitalnim snemalnikom (Marantz PMD 670) poslušali in snemali vse ultrazvočne klice netopirjev, ki smo jih kasneje analizirali s programom BatSound 4.0 (Pettersson Elektronik). Dodatno smo dvobarvne netopirje slišali ob nekaterih drugih priložnostih. Mnogo oseb je člane Slovenskega društva za proučevanje in varstvo netopirjev obvestilo o naključnih najdbah netopirjev, med njimi je bilo tudi nekaj opažanj dvobarvnega netopirja.

Med avtomobilskimi popisi smo prevozili nekaj več kot 500 km (Tab. 1) in pri tem slišali dvobarvne netopirje 59-krat na 58 mestih (Dod. 1), od tega njihove svatbene klice 43-krat. Dvobarvne netopirje smo slišali na šestih izmed devetih avtomobilskih transektih (Tab. 1, Dod. 1, Sl. 1), kjer je bilo povprečno število najdišč na kilometer 0,21 (razpon 0,09–0,39). Dvobarvni netopir je med avtomobilskimi popisi prevladoval s kar 76-odstotnim deležem opazovanj vseh netopirjev. Skupno smo s transektnimi in točkovnimi ultrazvočnimi popisi dvobarvnega netopirja slišali na 72 novih mestih, ki so ležala na nadmorskih višinah med 150 in 1.100 metri. Večinoma smo ga zabeležili v naseljih z vsaj eno cestno lučjo, vendar so se mnogokrat netopirji držali ob robu naselja, kjer je bila osvetljenost le rahla, gozd pa večinoma blizu. Po padajoči pogostosti smo dvobarvne netopirje slišali še v neosvetljenih naseljih, na gozdih jasah s kočami, ob gozdnih robovih, na jasah brez koč, enkrat pa tudi ob bregu reke. V Vincarjah in Kranjski Gori smo v stavbah našli dve poletni zatočišči skupin samcev (Sl. 1, mesti 1 in 2), od katerih je prva štela vsaj 50 osebkov, druga pa 11. Dodatno smo našli še enega posameznika, ki se je skrival pod slemenom strehe Falske graščine (Sl. 1, mesto 3). V Planinski jami smo našli štiri, v Hudi luknji pri Gornjem Doliču pa eno prezimujočo žival (Dod. 2, Sl. 1, mesti 4, 5), en osebek pa so našli med premikanjem predmetov v skladišču v Spodnji Rečici (Sl. 3, mesto 6). Med drugimi naključnimi najdbami (Dod. 2), ki so razporejene v obdobju oktober–maj (Sl. 2), so bili tako samci in samice. Čas najdb kaže, da se verjetno veliko dvobarvnih netopirjev k nam priseli na jesen in odseli spomladi.

Skupaj smo zbrali podatke o dvobarvnem netopirju z 98 novih mest v Sloveniji. Dvobarvni netopir je gotovo vrsta, ki stalno živi pri nas, vendar je morda tudi zaradi selitev pogosteje opazna v hladnejši polovici leta. Z dodatnimi jesenskimi popisi bi verjetno lahko hitro dokazali pojavljanje dvobarvnega netopirja v večjem delu Slovenije, pa tudi v sosednih pokrajinah.

# Acknowledgements

We are grateful to the many people who informed us about finds of *V. murinus*, allowed us to publish their observations on the species, or accompanied us on field trips. Thank you: Mitja Arh, Manca Černigoj, Vanja Debevec, Metka & Janez Demšar, Leif Gjerde, Martina Mirt Gradišnik, Katerina Jazbec, Tea Knapič, Lea Likozar, Zdravko Maher, Nejc in Luka Malenšek, Maxime Pastore, Cyril Schönbächler, David Stanković, Ksaver Šinkar, Samo Šturm, Urška Vide, Simon Zidar, Maja Zagmajster, Uroš Žibrat, Mihaela Kajzer Cafnik. We are also thankful two anonymous reviewers and Maja Zagmajster for suggesting improvements of the manuscript. The research was partly supported by the Republic of Slovenia's former Ministry of Spatial planning and Environment as well as by the Ministry of Agriculture and the Environment.

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**Appendix 1.** Ultrasound findings and possible mating sites of parti-coloured bat *Vespertilio murinus* in Slovenia in 2007–2012.
**Priloga 1.** Ultrazvočna opažanja in možna parišča dvobarvnega netopirja *Vespertilio murinus* v Sloveniji, zabeležena v letih 2007–2012.

Structure of records / Organizacija podatkov:
– Location / mesto najdbe, date /datum (surveyor / popisovalec)
(sc) – social calls (display song) / svatbeni klici, »/« – no *V. murinus* detected / dvobarvni netopir ni bil zabeležen

**Car transect surveys / Transektni popisi z avtomobilom (see Fig. 1 / glej Sl. 1)**
A – »Javorniki 1« 6.10.2009 (P. Presetnik): – Meadow Novi Lazi, along the Kozarišče-Mašun road, SW of the hill Pričev vrh (sc), – Hamlet Šranga (sc).
B – »Javorniki 2«, 1.10.2011 (P. Presetnik): – Hamlet Leskova dolina (sc); – Forest clearing round house 300 m west of the hill Mala kalvarija (sc); – Along the Leskova dolina-Mašun road, at the crossroad 1.9 km SE of Mašun; – Along the Leskova dolina-Mašun road, 700 m NNE from the mountain Puščetek (sc); – Southern part of the hamlet Mašun (sc); – Northern part of the hamlet Mašun (sc); – Forest clearing along the forester's hut (Bač 190) in Blagajeva dolina pri Blatni dolini (sc); – Forest clearing along the forester's hut at Vrh Korena (Palčje 66) (sc); – Forest clearing along the forester's hut Stara hiša (Palčje 68) (sc); – Forest clearing along the hunting hut at Otoška dolina; – Forest clearing along the hunting hut in Jurjeva dolina (sc); – Small forest clearing along the road, 320 m SSE of the hill Vrh vale; – Forest clearing along the forester's hut Laz (sc); – Forest road 1 km NNE of mountain pass Vratca (sc); – Hamlet Šranga.
C – »Krim–Rakitna«, 1.10.2011 (P. Presetnik): – /.
D – »Goteniška gora«, 4.10.2011 (P. Presetnik, M. Podgorelec, L. Likozar, L. Gjerde): – Small forest clearing along the road 3.1 km NW of Borovec pri Kočevski reki (sc); – Forest clearing along the road 2.7 km NW of Borovec pri Kočevski reki; – Hamlet Ravne; – Forest clearing along the cottage 370 m NE of the hill Beliški vrh (sc); – Forest clearing along the forester's hut Medvedjek; – Forest clearing around the hamlet Glažuta (sc); – Forest clearing around the hamlet Jelenov žleb.
E – »Banja Loka–Kočevski Rog«, 5.10.2011 (P. Presetnik): – /.
F – »Ljubljana«, 6.11.2011 (P. Presetnik, T. Knapič): – Parking lot in front of skyscrapers located at Bilčanska ulica 2 and 4 (sc); – Village Zgornja Hrušica (sc); – Street Hradeckega cesta; – Vicinity of the inn Gostilna Čad (sc); – Street Vodnikova cesta at building no. 46 (sc); – Crossroad of the streets Vodnikova cesta and Tržna ulica (sc).
G – »Črni vrh–Vrhnika«, 16.10.2012 (P. Presetnik): – Hamlet Na sredi near Zalog; – Forest edge 610 m SSE of the hill Špiček; – Vicinity of house at Idrijski Log 14 (sc); – Vicinity of the homestead Habeček (Idrijski Log 1) (sc); – NW end of the village Črni Vrh (sc); – Vicinity of the house at Črni Vrh 24 (sc); – Vicinity of the house at Črni Vrh 34 (sc); – Street NW of the church in Črni Vrh (sc); – NE end of the village Črni Vrh; – Hamlet Spodnje Grižе (sc); – At the turning off the Črni Vrh-Godovič road, towards the village Predgriže (sc); – Forest clearing around the homestead Klavžar (Predgriže 31); – Eastern part of the Godovič village; – Vicinity of the Godovič primary school(sc); – Hamlet Ivanje doline (sc); – Forest edge 245 m N of the homestead Kobal (sc); – Forest edge 100 m SW of the house at Rovtarske Žibrše 22 (sc); – Vicinity of the house at Rovte 1; – At turning off the main road in the village of Rovte towards the village of Smrečje (sc); – Vicinity of the Rovte church; – Hamlet Jamnik (sc).
H – »Bloška planota–Rakitna«, 17.10.2012 (P. Presetnik): Forest edge 430 m south of the church in Bloška Polica village (sc); – Centre of Bloška Polica (sc); – NW end of Bloška Polica village (sc); – At group of trees in the moor between the villages of Ravnik and Lahovo (sc); – Hamlet Jeršiče (sc); – Village Sveti Vid (sc); – Village Beč (sc); – At the stream pouring out of the lake at Rakitna village (sc).
I – »Dvor–Kočevska Mala gora«, 23.10.2012 (P. Presetnik, A. Hudoklin): – /.

**Foot transect surveys / Transektni popisi peš**
– Foot »monitoring« survey »Leskova dolina«, 3.10.2007 (P. Presetnik), 6.10.2009 (P. Presetnik), 11.10.2010 (P. Presetnik), 12.7.2011 (M. Podgorelec), 1.10.2011 (P. Presetnik), 17.10.2012 (P. Presetnik); – Foot »monitoring« survey »Kranjska Gora«, 18.7.2011 (P. Presetnik), Foot »monitoring« survey »River Soča – Most na Soči«, 1.8.2011. (M. Podgorelec); – Foot survey »River Sava – Zavrate«, 29.9.2010 (D. Stanković).

**Other point counts / Priložnosti točkovni popisi**
– Street Bevkova ulica (Cerkno) 7.10.2008 (P. Presetnik); – Vicinity of settlement Mašun (sc), 10., 11., 14., 15., 16.10.2008 (C. Schönbächler, M. Pastore); – Village Šmarje pri Jelšah (Šmarje pri Jelšah), 21.9.2010 (D. Stanković); – Forest edge at the turning off the main road towards the village of Nemški rovt (sc), 31.10.2010 (M. Zagmajster); – Vicinity of the house at Grajska cesta 59 (Bled) (sc), 23.10.2011 (P. Presetnik); – Vicinity of the Department of Biology building (Ljubljana) (sc), 3.11.2011 (P. Presetnik); – Vicinity of the rail road bridge, 90 m SE of the bridge Karlovški most (Ljubljana) (sc) 4.11.2011, 4.1.2012 (M. Podgorelec), Square Trg Republike (Ljubljana) (sc), 24.11.2011 (M. Podgorelec); – Forest edge and meadow N and NE of the church at Rakovnik (Ljubljana), 1.3.2012 (M. Podgorelec), Village Pudob (sc), 17.10.2012 (P. Presetnik), Street Tolstojeva ulica (Ljubljana) (sc), 14.10.2012, 17.10.2012, 14.11.2012 (P. Presetnik).

**Appendix 2.** Roosts and other locations including the measurements and notes regarding parti-coloured bat *Vespertilio murinus* in Slovenia from 2003 onwards.
**Priloga 2.** Zatočišča, druga najdišča, mere in opombe o dvobarvnih netopirjih *Vespertilio murinus* v Sloveniji od 2003 naprej.

Structure of records:
– Location / mesto najdbe [details of site if not mentioned in the text already/ podrobnejše mesto najde, če to ni omenjeno že v tekstu], date / datum, sex / spol (forarm length / dolžina podlakti [mm] / weight / masa [g]), notes, (informant / najditelj / assessor / določevalec); M – male / samec, F – female / samica, U – sex unknown / spol neznan; »-« – no measurement / meritev ni; survived – cared for until released / žival je bila oskrbovana do izpustitve.
* – site without details published in Presetnik et al. (2009) / najdba brez podrobnosti, objavljena v Presetnik et al. (2009)

**Roosts / zatočišča (see Fig. 1 / glej Sl. 1):**

1 – Mini Hotel, Vincarje 47 (Škofja Loka), 14.6.2009, M adult (44.2 / 13.0), M adult (41.9 / 11.0), M adult (45.1 / 14.0), immediately released (P. Presetnik);
2 – Block of flats Bezje 4, Kranjska Gora, 19.7.2010, M adult (42.7 / 14.0), M adult (44.8 / 16.0), M adult (44.8 / 13.0), M adult (44.9 / 16.0), M adult (41.2 / 12.5), M adult (45.1 / 14.5), M adult (44.1 / 14.0), M adult (44.6 / 12.0), M adult (44.4 / 13.5), M adult (44.2 / 13.5), immediately released (A. Petrinjak & L. Likozar);
3 – Cave, Planinska jama (Planina), 15.2.2011, M adult (46.2 / - ), M adult (44.4 / - ), immediately released (P. Presetnik & M. Podgorelec);
4 – Warehouse in the village Spodnja Rečica (Laško), 22.1.2013, U ( - / - ), immediately released (B. Vrabec / P. Presetnik);
5 – Cave, Huda luknja pri Zgornjem Doliču (Dolič), 9.2.2013, M adult (45.4 / 11.0), immediately released (M. Podgorelec & P. Presetnik).

**Other findings / druge najdbe**

– High block of flats at Bratovševa ploščad 38 (Ljubljana)* [on balcony], 4.10.2003, F nulliparous (42.7 / 14.0), exhausted, survived (U. Žibrat); – House at Brezje pri Tržiču 62 (Brezje pri Tržiču)* [on balcony], 11.4.2004, M adult (- / -) injured, died (M. Zagmajster); – House at Na Gmajni 6 (Pijava Gorica)* [on the outside staircase], 29.4.2005, M adult (41.0 / 8.0), exhausted, died (P. Presetnik); – Block of flats at Zikova ulica 2 (Kamnik), 7.12.2005, M adult (44.6 / 12.5), exhausted, survived (M. Zagmajster); – Primary school Dravlje, Klopčičeva ulica 1 (Ljubljana) [on ground in front of the building], 14.11.2006, M adult (- / -) exhausted, died (N. & L. Malenšek / M. Zagmajster); – Faculty of Social Sciences, Topniška ulica 31 (Ljubljana) [on ground in front of the building], 14.3.2009, F adult (43.2 / 8.5) injured, died (P. Presetnik); – Unfinished building near house at Jezerska cesta 12 (Kranj) [small unsheltered crevice on facade], 8.4.2009, F (43.8 / 10.0), immediately released (A. Petrinjak); – Factory, Iskra Mehanizmi, Lipnica 8 (Kropa) [in pile of waste material], 5.11.2009, F adult (44.1 / 12.0), immediately released (A. Petrinjak); – District Court of Sežana, Kosovelova ulica 1 (Sežana) [in between windows], 1.12.2009, M adult (42.8 / 9.5), injured, died (V. Debevc Gerjevič & S. Šturm / A. Petrinjak); – Primary school Stane Žagar, Cesta 1. maja 10a, (Kranj) [flew into the class room], 8.1.2010, M adult (41.6 / 10.0), immediately released (A. Petrinjak & Lea Likozar); – House at Rožna dolina 2 (Lesce) [crawling in the ventilation shaft of bathroom], 3.10.2010, U (- / -), immediately released (M. Arh / (M. Podgorelec); – Skyscraper at Jakčeva ulica 2 (Ljubljana) [flying on 11th floor], 14.12.2010, M adult 43.4 13.0), survived (P. Presetnik); – Block of flats at Ulica Iga Grudna 19 (Ljubljana), 18.1.2011, M adult (- / -), injured, died (J. Mlakar); – House at Pod hribom 36 (Ljubljana) [collided with window], 23.2.2011, U (- / -), immediately released (U. Vide / M. Podgorelec); – Uninhabited forester's hut, Stara koča (Windischgraetz mansion) [on ground floor], 20.3.2011, M (- / -) fresh carcase (T. Delić); – Primary school at Ljubečna, 18.5.2011, U (- / -), immediately released (M. Mirt Gradišnik / M. Podgorelec); – Skyscraper at Dunajska cesta 5 (Ljubljana) [on the highest floor], 16.1.2012, M adult (44.8 / 9.0), exhausted, survived (S. Zidar); – House at Strahinj 52, 22.1.2012, U (- / -), immediately released (K. Šinkar / A. Petrinjak); – Multi-storey building at Kotnikova 5 (Ljubljana) [inside building], 27.3.2012, M adult (44.8 / 11.5), exhausted (S. Zidar); – Building of Narodni Dom Mežica [on floor in front of the building], 10.11.2012, U (- / -), exhausted, survived (Z. Maher / M. Podgorelec); – Skyscraper at Plečnikova ulica 5 (Maribor) [on balcony of 5th floor], 28.2.2013, M adult (45.1 / -), fresh carcass (M. Kajzer Cafnik / M. Podgorelec); – House Ravbarkomanda 8 (Postojna) [in cellar], 3.4.2013, F adult (46.2 / 12.0), exhausted, survived (M. Černigoj / M.Podgorelec); – House Savska cesta 3 (Radovljica), 12.4.2013, M (45.2 / -), injured, died (Anonymus / A. Petrinjak).

NATURA SLOVENIAE 15(2): 51-55
SHORT COMMUNICATION

Prejeto / Received: 4.10.2013
Sprejeto / Accepted: 21.11.2013

# New data on the distribution of the Italian agile frog *Rana latastei* Boulenger, 1879 in Slovenian Istra

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**Abstract.** After the first confirmed record of the Italian agile frog in the Dragonja River Valley, a herpetological field survey was organized in 2012 to estimate the species range in this area. We confirmed its reproduction in the Slovenian part of the watersheds of the rivers Dragonja, Mirna and upper part of Rižana. Here we present a preliminary report on the presence of this amphibian in the Slovenian part of Istra.

Key words: *Rana latastei*, Slovenia, Istra, breeding sites, distribution, Natura 2000, SCI SI3000212 Slovenska Istra

**Izvleček. Novi podatki o razširjenosti laške žabe (*Rana latastei* Boulenger, 1879) v slovenski Istri –** Na območju slovenske Istre je bil po prvi potrjeni najdbi laške žabe v dolini reke Dragonje v letu 2012 organiziran herpetološki popis tega območja. Popis je potrdil razširjenost in razmnoževanje te dvoživke v slovenskem delu povodij rek Dragonje in Mirne ter v zgornjem delu Rižane. V pričujoči znanstveni vesti so opisani preliminarni rezultati o razširjenosti laške žabe v Slovenski Istri.

Ključne besede: *Rana latastei*, laška žaba, Slovenija, Istra, mrestišča, razširjenost, Natura 2000, SCI SI3000212 Slovenska Istra

## Introduction

The Italian agile frog (*Rana latastei* Boulenger, 1879) is an endemic species of the wider Padano Venetian plain area (Grossenbacher 1997, Poboljšaj & Lešnik 2003, Barbieri & Mazzotti 2006, Sindaco et al. 2009, Kuljerić 2011). The species' eastern distribution range was inadequately understood until recently. Until the late 1990s, this species had been known only from the Panovec forest near Nova Gorica in Slovenia (Poboljšaj 1998, Poboljšaj & Lešnik 2003) and from a few localities in the Croatian part of Istra – forests near Pazin, Motovunska Šuma and three small valleys near the Slovenian border (Kuljerić 2011). Due to Natura 2000 implementation, extensive field surveys both in Slovenia and Croatia have been carried out;

results showed that the species' range is much wider (Kuljerić 2009, 2011, Lešnik et al. 2011). In Slovenia, *Rana latastei* is abundant in the Vipava River Valley, along the Branica River and in Goriška Brda (Poboljšaj & Lešnik 2005, Lešnik et al. 2011). However, there are also a few records from the Idrija River, which runs along the Italian border (Cipot 2005a, Lešnik et al. 2011). The Italian agile frog has also been searched for in the Dragonja River Valley, where it was confirmed just recently (Cipot 2005b, Poboljšaj 2007, Glasnović 2012). Glasnović (2012) reported the finding from the woodland slopes of Suje along the left bank of the Dragonja. The occurrence of *R. latastei* in this area is primarily associated with populations in the Croatian part of Istra. In Croatia, it is most abundant along the Butoniga River and its tributaries, and in the middle part of the Mirna River Valley, from where its distribution spreads southwards and northwards. In the south it crosses into the Pazinčica watershed north of Pazin, while in the north it reaches the Slovenian border, where it can be found in the right bank tributaries of the Mirna River (Kuljerić 2009, 2011).

Due to the species discovery in the Dragonja River Valley and new data on its distribution in Croatia (Kuljerić 2009, 2011), a herpetological field survey in the Slovenian part of Istra was organized in 2012. The aim of this contribution is to present preliminary results on the occurrence of the Italian agile frog in the Slovenian part of Istra. Most of the results presented here were collected during a herpetological survey conducted by »Societas herpetologica slovenica« and »Centre for Cartography of Fauna and Flora«; we also present other findings from 2012.

## Material and methods

The survey took place on 31. 3. 2012. Eight participants were divided into four groups in order to cover as much ground as possible in such a short time. The survey area was limited to the middle and upper Dragonja River Valley, the Rokava stream and to the tributaries of the Mirna River. The potential breeding sites to be surveyed were selected in accordance with the breeding ecology of *R. latastei* in hilly parts of Slovenia and Croatia: clean, small and shaded streams with slow flow and small river-pools with submerged branches as well as the River Dragonja itself (Kuljerić 2011, Lešnik et al. 2011). The teams (consisting of two people) examined the streams by walking along them and searching for egg clutches. The locations with *R. latastei* spawn were noted with a GPS, photographed and the number of clumps was recorded. Even though egg clutches of *R. latastei* and *R. dalmatina* are similar, they can be distinguished by the characteristic manner of egg deposition. Females of *R. latastei* usually deposit their eggs in groups and attach them to diagonally submerged branches or roots. In most cases, clutches stay submerged and attached even after embryonic development finishes. By way of comparison, females of *R. dalmatina* deposit somewhat bigger clutches that are usually more uniformly dispersed throughout the water body and are individually attached to vertical vegetation. In most cases, older clutches detach from the submerged vegetation and float on the surface (Baumgartner 1996, Brstilo & Skaberne 2005, Poboljšaj & Lešnik 2005, Ficetola 2005, Veenvliet & Kus Veenvliet 2008).

## Results and discussion

Reproduction of *R. latastei* was confirmed in the middle part of the Dragonja River, in the lower and middle parts of its tributary the Rokava stream, in the Lukinska vala, in the Rakovec stream (a tributary of the Rižana) and in Malinska, Miklinica, Pregon, Mlaka and Reka streams – all tributaries to the Mirna River in Croatia (Fig. 1).

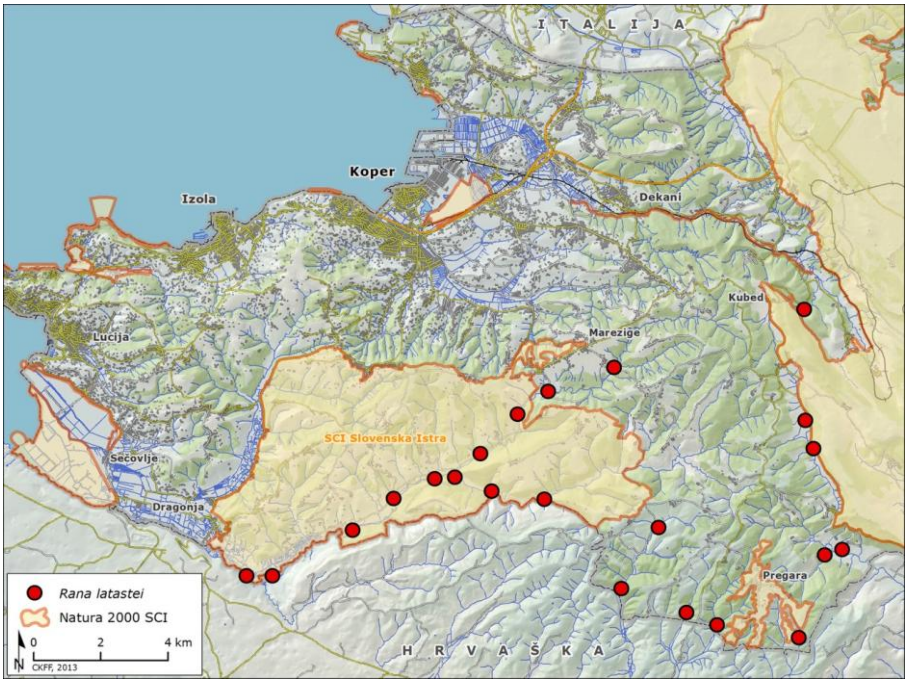


**Figure 1.** Known breeding sites of the Italian agile frog *Rana latastei* in the Slovenian part of Istra.
**Slika 1.** Poznana mrestišča laške žabe *Rana latastei* v slovenski Istri.

The Italian agile frog is one of Europe's most endangered amphibians; it is a strictly protected species under the Bern convention (Appendix II) and listed as globally vulnerable (VU) by the IUCN (Sindaco et al. 2009). In Slovenia, it is legally protected by the Decree on Protected Wild Animal Species (Ur. l. RS 2004a,) and listed as an endangered species (E) in the »Slovenian Red Data List« (Ur. l. RS 2002). Moreover, it is also protected by the EU Habitats Directive 92/43/EEC (listed in Annexes II and IV).

In Slovenia, three Natura 2000 sites where *R. latastei* was included as a qualification species were designated by the Decree on special protection areas (Ur. l. RS 2004b): SCI SI3000226 Dolina Vipave, SCI SI3000225 Dolina Branice and SCI SI3000255 Trnovski gozd – Nanos. The last change of the Decree (Ur. l. RS 2013) also includes the findings presented here; *R. latastei* is therefore now a qualification species for SCI SI3000212

Slovenska Istra (Fig. 1) as well. This area covers most of the breeding sites recorded during this study – the Dragonja River Valley and the lower course of the Rokava stream with its tributaries. Furthermore, *R. latastei* populations along the Miklinica, Pregon and Mlaka tributaries to the Mirna River are also protected on the Croatian side of the border, where they are included in the proposed SCI HR200105 Pregon, with *R. latastei* also a qualification species (Marković et al. 2012).

This communication does not yet present a complete picture of the distribution and status of *R. latastei* in Northern Istra. Future efforts should be focused on both monitoring the abundance of this species in known breeding areas and on searching for new localities where this species occurs. Only additional research can provide us with an accurate insight into the distribution and status of the Italian agile frog in the Slovenian part of Istra, on the basis of which adequate protection measures can be implemented.

## Acknowledgements

We are grateful to all the participants of the herpetological field survey (Ana Lazar, Daniela Vlačić, Primož Presetnik, Aja Zamolo, Tea Knapič, Martina Kogoj and Maja Sopotnik) and to Martina Lužnik and Peter Glasnović for the data they additionally contributed. We would also like to express our thanks to Ali Šalamun and Aleksandra Lešnik for their help with data analysis and cartography.

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NATURA SLOVENIAE 15(2): 57-61
SHORT COMMUNICATION

Prejeto / Received: 23.4.2013
Sprejeto / Accepted: 10.7.2013

# A case of massive infestation of a male green lizard *Lacerta viridis/bilineata* by castor bean tick *Ixodes ricinus* (Linnaeus, 1758)

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**Abstract.** Infestation by ticks affects several vertebrate groups, including reptiles. Castor bean tick *Ixodes ricinus* is the most widespread tick species. Here we report an impressive tick infestation of a male green lizard *Lacerta viridis/bilineata* found in 2012 in the vicinity of Bilpa cave in the Kolpa valley, Slovenia. Lizards as tick hosts can play an important role in the life cycle of *I. ricinus* and may also be potential vectors of Lyme disease.

Key words: *Lacerta viridis/bilineata*, *Ixodes ricinus*, tick, host, Slovenia

**Izvleček. Primer močne zaparazitiranosti pri samcu zelenca *Lacerta viridis/bilineata* z gozdnimi klopi *Ixodes ricinus* (Linnaeus, 1758) –** Zaprarazitiranost s klopi je pogost pojav pri večini skupin vretenčarjev, tudi pri plazilcih. Najbolj razširjena vrsta klopa je gozdni klop *Ixodes ricinus*. Pri samcu zelenca *Lacerta viridis/bilineata*, ki smo ga ujeli leta 2012 v bližini jame Bilpa v dolini Kolpe, Slovenija, smo opazili izjemno močno zaparizitiranost z gozdnimi klopi. V splošnem so kuščarji gostitelji klopov in igrajo pomembno vlogo v življenjskem krogu vrste *I. ricinus*, hkrati pa so tudi potencialni vektorji borelije.

Ključne besede: *Lacerta viridis/bilineata*, *Ixodes ricinus*, klop, gostitelj, Slovenija

## Introduction

In Slovenia, two species of green lizards are currently recognised: *Lacerta viridis* (Laurenti, 1768) and *Lacerta bilineata* (Daudin, 1802) (Böhme et al. 2006, Krofel et al. 2009), but the new revision of their genetic status is currently under review (Marzahn et al. 2013). Adult individuals of these two species are difficult to distinguish in the field (Krofel et al. 2009, Breg et al. 2010). Their general characteristics are: adults mainly green with black speckles, most pronounced in females (Breg et al. 2010); in the breeding season, males display prominent blue and yellow chests and throats, with some females also having throats with

vibrant yellow and some blue, although this is not as pronounced as in males (Václav et al. 2007); adults can grow up to 45 cm from head to tip of the tail (Breg et al. 2010).

A total of 16 tick species (Acarina: Ixodina) have been reported for Slovenia (Trilar 2004), with the most widespread species among them being castor bean tick *Ixodes ricinus* (Linnaeus, 1758). *Ixodes ricinus* needs three hosts to complete its life cycle (larva, nymph, adult) and that takes at least three years to complete (Wall & Shearer 1997, Gryczyńska-Siemiątkowska et al. 2007). Adults of this species are red-brown and grow 2.5–4 mm in length on average, but females can reach even up to 10 mm in length (Wall & Shearer 1997). Mammals, birds and lizards are the three most important hosts (Wall & Shearer 1997, Majláthová et al. 2006, Gryczyńska-Siemiątkowska et al. 2007). Tovornik & Brelih (1980) suggest that lizards mainly represent a supplementary food source for ticks, playing a key role in cases when endothermic hosts are either temporally or locally unavailable in the environment. In some cases, lizards can act as the principal host for larva and nymphs (e.g. Slovak Karst – southeastern part of Slovakia, Majláthová et al. 2006, Václav et al. 2007).

Tick infestation in lizards is becoming a more frequent study subject owing to a higher number of tick-borne diseases that can affect humans (Gryczyńska-Siemiątkowska et al. 2007). In lacertid lizards, male-biased tick infestation has already been demonstrated in several studies and there are several hypotheses to explain this bias: increased level of testosterone – testosterone-implanted males increased their tick load (Salvador et al. 1996), and larger home ranges – there is a positive correlation between bigger lizards and their home ranges area (Perry & Garland 2002). Consequently, these animals will probably move more to defend their territory; therefore they could be more exposed to ticks (Bauwens et al. 1983, Gryczyńska-Siemiątkowska et al. 2007). Infestation of lizards by ticks may alter its blood parameters and therefore affect the lizard performance promoting shifts in physiology and behaviour (Salvador et al. 1996). Nonetheless, ticks parasiting lizards exceed the pure scientific interest since they are recognised as potential vectors for *Borrelia* spirochetes causing Lyme disease, i.e. a vector-borne human disease in the temperate zone of the Northern Hemisphere (Földvári et al. 2009). Wherefore lizards can also play an important role in the life cycle of *I. ricinus* and therefore *Borrelia* spirochetes.

## Material and methods

On 18. 5. 2012, the second author caught by a noose (Garcia-Muñoz & Sillero 2010) an adult male of *L. viridis/bilineata* (Tab. 1, still not analysed with genetic markers) in the vicinity of Bilpa cave in the Kolpa valley, Slovenia (Gauss Krüger coordinates: x = 497408, y = 40941, 200 m a.s.l.). The landscape was characterized by bushy vegetation on gravel back yard of a house under construction. A small stream that is a tributary of the Kolpa river flows nearby, while the surroundings are overgrown with mixed forest.

**Table 1.** Green lizard *Lacerta viridis/bilineata* biometric measurements. Standard biometric measurements of the male green lizard *Lacerta viridis/bilineata* caught in the vicinity of Bilpa cave, southern Slovenia.
**Tabela 1.** Biometrične meritve zelenca *Lacerta viridis/bilineata*. Standardne biometrične meritve samca zelenca *Lacerta viridis/bilineata*, ujetega v bližini jame Bilpa, južna Slovenija.

| Body measurement / Telesna mera | Length (mm) |
|---|---|
| Snout-vent length / dolžina glave in trupa | 120.4 |
| Head length / dolžina glave od konice gobca do ovratnika | 44.6 |
| Pileus length / dolžina pileusa | 28.4 |
| Head width / širina glave | 21.9 |
| Head height / višina glave | 14.9 |

# Results and discussion

We noticed many ticks on the body of the lizard and counted a total of 84 ticks. The majority of ticks were collected and stored in ethanol by the second author. This number of ticks is higher than previously reported (Václav et al. 2007 – maximum number 64 ticks/host in males, Gryczyńska-Siemiątkowska et al. 2007 – maximum number of 38 ticks/host, Földvári et al. 2009 – maximum number 47 ticks/host), except for Cafuta (2005) in Slovenia, where the author counted 104 nymphs on an individual of *L. viridis/bilineata*. We found nymphs almost on the entire body: top of the head, mouth, ears and eyes, between the ears and legs, behind front legs, near the cloaca and around hind legs (Fig.1). Although the animal was severely infested with ticks, it showed no sign of being sick (i.e. normal movements, not too thin, the skin in good condition and the colouration normal).

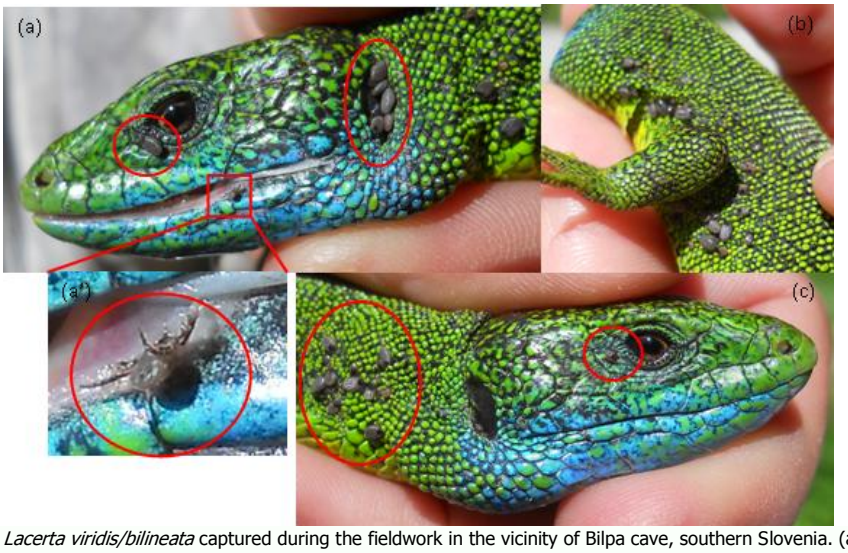


**Figure 1.** *Lacerta viridis/bilineata* captured during the fieldwork in the vicinity of Bilpa cave, southern Slovenia. (a) Nymphs of *Ixodes ricinus* attached next to the eye, inside the ear and near the mouth (a'); (b) great number of nymphs attached in the area around the front left limb; (c) nymphs attached near the front right limb and near the eye.
**Slika 1.** *Lacerta viridis/bilineata*, ujet med terenskim delom v bližini jame Bilpa, južna Slovenija. (a) Nimfe gozdnega klopa (*Ixodes ricinus*) pritrjene blizu očesa, v ušesu okoli bobniča in ob ustih (a'); (b) veliko število nimf pritrjenih okoli sprednje leve noge; (c) nimfe pritrjene blizu sprednje desne noge in ob očesu.

In the comparison study of infestation of lacertids by Cafuta (2005), the species with the highest prevalence and intensity of infestation by *I. ricinus* was the *L. viridis/bilineata*. Tovornik & Brelih (1980) also reported infestation of this lizard species with *I. ricinus* at three different localities, while on a site at Postojna the ticks were identified as *Haemaphysalis punctata* (Canestrini & Fanzago, 1878). The highest number of ticks found on a single individual of *L. viridis/bilineata* was 10 for *H. punctata*, and four for *I. ricinus* (Tovornik & Brelih 1980). This is yet another report that confirms incidental observation suggesting that in Slovenia the infestation of *I. ricinus* nymphs on the *L. viridis/bilineata* is a frequent event and that this reptile host plays an important role for the parasite. Nevertheless, mammals and birds tend to be more parasitized by *I. ricinus* than lizards (Bauwens et al. 1983, Gryczynska-Siemiatkowska et al. 2007, Gwiazdowicz & Filip 2009), which confirms that they tend to represent subsidiary hosts. However, increased infestation rates in lacertid lizards associated with the presence of ungulates have recently been reported (Pafilis et al. 2013). Further studies should investigate eventual links between the abundance of wild ungulates in Slovenian forests (Stergar et al. 2009) and the high levels of parasitisation by ticks of the lacertid communities inhabiting the same environments (Cafuta 2005), and whether they may act as an effective reservoir for *Borrelia* (Gryczynska-Siemiatkowska et al. 2007, Majáthová et al. 2013).

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