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ZNANSTVENI ČLANKI / SCIENTIFIC PAPERS

Božo FRAJMAN et. al: Floristic records from the Karavanke/Karawanken and Kamniške alpe/Steiner Alpen (Slovenia and Austria) / FLORISTIČNE ZANIMIVOSTI KARAVANK IN KAMNIŠKIH ALP (SLOVENIJA IN AVSTRIJA)	5
Maja ZAGMAJSTER & Ľubomir KOVÁČ: Distribution of palpigrades (Arachnida, Palpigradi) in Slovenia with a new record of <i>Eukoenenia austriaca</i> (Hansen, 1926) / RAZŠIRJENOST PALPIGRADOV (ARACHNIDA, PALPIGRADI) IN NOVA NAJDBA VRSTE <i>Eukoenenia austriaca</i> (HANSEN, 1926) V SLOVENIJI	23
Primož PRESETNIK & Nataša ZUPANČIČ: Netopirji v prezimovališčih v Beli krajini pozimi 2001-2002 / BATS IN HIBERNACULA OF BELA KRAJINA (SOUTHEASTERN SLOVENIA) IN THE WINTER OF 2001-2002.	33

RECENZIJA / REVIEW

Maarten de Groot: Van Veen (2002): Hoverflies of Northwestern Europe, Identification keys to the Syrphidae.	43
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Floristic records from the Karavanke/Karawanken and Kamniške Alpe/Steiner Alpen (Slovenia and Austria)

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Abstract. New floristic records from the eastern Karavanke/Karawanken and Kamniške Alpe/Steiner Alpen (Slovenia and Austria) are reported. *Allium kermesinum* is new for Austria; *Arabis soyeri* subsp. *subcoriacea*, *Carex rupestris* and *Draba dubia* are new for the Kamniške Alpe/Steiner Alpen; for *Androsace hausmannii*, *Arabis stellulata*, *Carex ornithopodoides*, *Pedicularis rosea*, *Salix serpyllifolia* and *Veronica fruticulosa* new localities are presented. Furthermore, taxonomic problems in *Oxytropis* sect. *Oxytropis* and *Arabis pumila* sensu lato are discussed.

Key words: floristic mapping, Southeastern Alps, alpine flora, high mountain taxa

Izvešček. FLORISTIČNE ZANIMIVOSTI KARAVANK IN KAMNIŠKIH ALP (SLOVENIJA IN AVSTRIJA) - Predstavljamo floristične novosti iz vzhodnih Karavank in Kamniških Alp (Slovenija in Avstrija). *Allium kermesinum* je nova vrsta za Avstrijo; *Arabis soyeri* subsp. *subcoriacea*, *Carex rupestris* in *Draba dubia* so nove za Kamniške Alpe. Dodajamo tudi nekaj novih nahajališč nekaterih redkejših taksonov: *Androsace hausmannii*, *Arabis stellulata*, *Carex ornithopodoides*, *Pedicularis rosea*, *Salix serpyllifolia* in *Veronica fruticulosa*. Razpravljamo tudi o taksonomski problematiki znotraj *Arabis pumila* sensu lato in sekcije *Oxytropis* sect. *Oxytropis*.

Ključne besede: kartiranje flore, Jugovzhodne Alpe, alpinska flora, visokogorske rastline.

Introduction

Situated at the eastern edge of the Southern Calcareous Alps, the mountain ranges of Karavanke/Karawanken and Kamniške (Savinjske) Alpe/Steiner (Sanntaler) Alpen provide, just before sinking below the timberline, a broad variety of habitats and a full sequence of altitudinal belts that is the necessary requirement for rich and diverse mountain flora. Compared with other parts of the Alps, the distance to and the somewhat weak connection with the higher and larger alpine areas in the West (Julijske Alpe/Alpi Giulie, Karnische Alpen/Alpi Carniche/Karnijske Alpe) may be the reason for a certain decline of strictly high-alpine species. On the other hand, the position outside the continuous ice-shields that had covered the basins and valleys adjacent to the West and North, but not to the East and South during the cold phases of the Quaternary (van Husen 1987), has designed the area as a favourable survival area or »massif de refuge«, as testified by a high concentration of plant and animal species with restricted, disjunct and even endemic distributions. Though this particular combination of biogeographic features is basically well established for our area, a refined knowledge of distributional traits appears desirable as a basis for future in-depth analyses.

Regarding the Kamniške Alpe and the eastern part of the Karavanke Mts, botanical knowledge dates back to the 18th century, when J. A. Scopoli (1760) visited Storžič and Grintovec and F. X. Wulfen explored the mountains Grintovec, Obir and Peca/Petzen (see e. g. Klemun 1999). Among the scattered notes published in the 19th century, those by Weiss (1859) and Kocbek (1891, 1894) from Kamniške Alpe may be mentioned. Intensive floristic fieldwork, combined with early vegetation mapping, was undertaken from 1898 to 1905 by A. Hayek in the central Kamniške Alpe. The floristic results of this study, together with additional data by A. Paulin and others, were jointly published in 1907 by Hayek & Paulin. Up to now, this remained the only such detailed floristic publication for the whole Kamniške Alpe and the Karavanke region. For other parts of the region, the data collected up to that time are summarized in the provincial floras for Carinthia by Pacher & Jabornegg (1880-1888) and Pacher (1888-1894), and for historical Styria by Hayek (1908-1914, 1956).

Later, in Slovenia mostly fragmentary floristic and/or taxonomic reports were published, e.g. for Kamniške Alpe by Rechinger (1935), Mayer (1951, 1954a & 1954b), Prekoršek (1956a & 1956b), Strgar (1973), Wraber (1978 & 1995), Cenčič (1997), and for the eastern Karavanke by Sušnik (1961), Melzer (1970), Dakskobler & Mayer (1992), Jogan (1995). A cartographic summary of the published or otherwise accessible data is provided by the map series by Jogan et al. (2001).

For the Austrian portion, floristic records were published in many contributions covering wider territories (mostly Carinthia as a whole or Austria as a whole). Among taxonomic novelties, the endemic species *Helictotrichon petzense* Melzer and *Pulmonaria carnica* W. Sauer, soon detected also in Slovenian territory, were most noteworthy (Melzer 1968a, Sauer 1973). The flora of two mountains in the eastern Karawanken was described in particular: that of Petzen/Peca by Melzer (1968b), and that of Obir by Hartl & Türk (1999), Leute & Zwander (1999), and Perko (1999). Towards the end of the 1960s, methodical floristic field work was started throughout Austria within the scheme of Mapping the Flora of Central Europe. For Carinthia, in 1992 the results achieved by then were published in a regional distribution atlas (Hartl & al. 1992). At that time, the average number of taxa recorded per quadrant had reached approximately the value of 645 for the 16 purely or partly Austrian quadrants of our area. This was backed by the – mainly voluntary – fieldwork of about 20 botanists (among which four, namely O. Pruggert†, G. Kniely, A. Neumann† and L. Schratt-Ehrendorfer, had contributed more than half of the records), and by the additional use of literature and collection data, the latter mainly extracted from the herbarium KL at Klagenfurt. In the meanwhile, the area's vascular plants were also included into the new Flora of Austrian Styria and adjacent regions (Maurer 1996-2006), and an essentially updated set of distribution maps for the *Orchidaceae* of Carinthia was provided by Perko (2004).

In addition to the flora, plant communities were studied in manifold investigations that, however, cannot be listed here in detail. We just like to remember that our area's vegetation was the subject of one of the classical regional monographs, namely by Aichinger (1933), as they coined the early time of Braun-Blanquetian phytosociology, and that the alpine vegetation of the central Kamniške Alpe was, 75 years after Hayek, newly analysed in phytosociological terms by Haderlapp (1982), treating both the Slovenian and the Austrian side.

Rare and endangered species in the Slovenian part of the area were documented by Wraber & Skoberne (1989), those in the Austrian part by Kniely et al. (1995).

This paper presents new records of rare, mainly alpine plant species from the eastern Karavanke/Karawanken and Kamniške (Savinjske) Alpe/Steiner Alpen that were mainly recorded during fieldwork executed within the framework of Mapping the Flora of Central Europe. These excursions were conducted by the Department of Plant Biogeography and Botanical Garden, University of Vienna, in 2003 and 2005.

Study area, materials and methods

The 2003 excursion covered mainly the Austrian side of the western and central parts of the Karawanken, but also excursions to the eastern Karawanken were included (e.g. Tolsta Košuta), and Slovenian territory was touched on the border ridge. In 2005, we focussed on the subalpine to alpine vegetation belts on both sides of the eastern part of the Karavanke and Kamniške Alpe. In Austria, we visited botanically less known portions of Obir and Petzen/Peca, furthermore Reschounikturm/Režovnikovo poldne, Kleiner Grintoutz/Virnikov Grintovec, Kärntner Storschitz/Pristovnikov Storžič, the western summit of Uschowa/Olševa, and Oistra/Ojstra (Karawanken), and Vellacher Kotschna/Belska Kočna including Velika Baba (Steiner Alpen). In Slovenia, field work concentrated on the border area between Savinjsko sedlo and Jenkova planina, the area between Kamniško sedlo and Ojstrica, and on Storžič and Raduha (all Kamniške Alpe), as well as to Virnikov Grintovec and Olševa in the Karavanke. All species observed along the excursion routes were marked on the standardized terrain forms used by the Austrian floristic mapping scheme (see e.g. Niklfeld 1971); later, the records were entered into the floristic database at the Department of Plant Biogeography and Botanical Garden, University of Vienna. The most interesting results are presented herewith.

Taxonomy and nomenclature follow Fischer et al. (2005). Distribution data were taken from Hartl et al. (1992) for Carinthia (Austria) and Martinčič et al. (1999) as well as Jogan et al. (2001) for Slovenia. Herbarium specimens are deposited in the herbaria of the Institute of Botany, University of Vienna (WU), of the Museum of Nature South Tyrol in Bozen/Bolzano (BOZ) and of the Biology Department, University of Ljubljana (LJU).

»Southeastern Alps« refers to Julijske Alpe, Karavanke and Kamniške Alpe (and occasionally includes also Mt. Dobratsch/Dobrač in the easternmost part of Gailtaler Alpen/Ziljske Alpe). The Slovene resp. German names of the main mountain groups, i. e. Kamniške Alpe = Steiner Alpen and Karavanke = Karawanken, are used alternatively, subject to which national territory is concerned. Otherwise, in the bilingual area of Austria toponyms are mostly given in both languages

Abbreviations for collectors or observers are: AH (Andreas Hilpold), BF (Božo Frajman), ES (Erich Sinn), GMS (Gerald M. Schneeweiß), HN (Harald Niklfeld), LSE (Luise Schratt-Ehrendorfer), PP (Peter Pany), PS (Peter Schönschwetter), SL (Sonja Latzin), and ThE (Thorsten Englisch).

Results and discussion

***Allium kermesinum* Rchb.**

- Slovenia, Kamniške Alpe: SE of Savinjsko sedlo, ca. 2000 m s. m. (9653/1). PS, BF, PP, 31.8.2005.
- Austria and Slovenia, Kamniške Alpe/Steiner Alpen: saddle ca. 260 m SSE of Velika Baba, ca. 1960-1980 m s. m., both sides of the border (9653/1). PS, BF, PP, 31.8.2005 (WU).

New for Austria. *Allium kermesinum* is a narrow endemic of the Kamniške Alpe (Mayer 1960) and was previously only known from Slovenian territory. Our record for Austria is from the immediate vicinity of the state border.

***Androsace hausmannii* Leybold**

- Slovenia, Kamniške Alpe: Planjava, 2390 m s. m. (9653/2). PS, BF, PP, 1.9.2005 (WU).

New record of a rare species in the Kamniške Alpe. This eastern-alpine endemic species has its main distribution area in the Southern Alps (mainly Dolomiten/Dolomiti and Karnische Alpen/Alpi Carniche of Italy and Austria), with some disjunct populations in the eastern Central Alps as well as in the Northern Calcareous Alps of Austria and Germany (Merxmüller 1953, Niklfeld 1972, Niklfeld 1973). In Slovenia, *A. hausmannii* is rare and apparently confined to the Kamniške Alpe. It was first found by L. Rechinger on the summit of Skuta (Rechinger 1935). Later on, more localities on Skuta and neighbouring Rinka were recorded (Mayer 1956). *Androsace hausmannii* is included as a rare species in the Red Taxa List of Slovenia (Anonymus 2002).

The newly recorded small population on the summit of Planjava is several kilometres away from the known localities. *Androsace hausmannii* grows in the vicinity of *Draba aspera* Bertol., another rare species that, in the Alps, is restricted to the Kamniške Alpe (Hayek & Paulin 1907) and one locality in the eastern Karawanken (Gutermann 1972).

***Arabis soyeri* Reut. et Huet *subsp. subcoriacea* (Gren.) Breistr.**

- Austria, Steiner Alpen: middle part of Vellacher Kotschna (Belska Kočna), below Offnerhütte, 1300-1450 m (9653/1). PS, BF, PP, 31. 8. 2005.

New for the Steiner Alpen/Kamniške Alpe. In contrast to the situation in the Central Alps of Carinthia, where this taxon is frequently growing in base-rich springs and along streams, it is rare on the Austrian side of the Karawanken/Karavanke with one record near Zell Pfarre/Sele Fara (Titz & Weigerstorfer 1976) and two records from Petzen/Peca and its foothill area (mapping data by O. Prugger, presented in Hartl et al. 1992). From the southern side of the Karavanke, *A. soyeri* seems to be entirely absent. It was previously not known from the Steiner Alpen/Kamniške Alpe. In Slovenia, three records exist from Julijske Alpe and Trnovski gozd (Jogan et al. 2001); one more record is given by Titz & Weigerstorfer (1976) for the Sava valley near Kranj.

***Arabis stellulata* Bertol.**

- Austria, Karawanken: ENE ridge of Kuhberg/Kravji vrh (SW of Hochobir/Ojstrc), 1950-2000 m s. m. (9552/2). SL, HN, 31.8.2005.
- Austria, Karawanken: Wackendorfer Spitze/Veška kopa (Petzen/Peca), 2000-2100 m s. m. (9454/3). SL, BF, ES, 29.8.2005.
- Austria, Karawanken: »Mela« E below Tolsta Košuta, 1550-1690 m s. m. (9552/4). SL, 11.7.2003.
- Austria, Karawanken: Kleiner Grintoutz/Virnikov Grintovec, 1320-1654 m s. m. (9552/4). PS, BF, 3.9.2005.
- Austria, Karawanken: northeastern part of Trögernklamm/Korške peči, 680-750 m s. m. (9553/1). W. Gutermann & HN, 8. 6. 1980; HN, SL, PP, ES, 28.8.2005.
- Austria, Karawanken: northern slope of Uschowa/Olševa NE below Felsentore/Vrate, 1060-1200 m s. m. (9554/1). PS, BF, AH, PP, 30.8.2005.
- Slovenia, Karavanke: southern slope of Olševa E – NE above Potočka zijalka, 1675-1820 m s. m. (9554/3). PS, AH, BF, PP, 30.8.2005.
- Slovenia, Kamniške Alpe: Raduha, between Durce and Lanež, ca. 1780-1925 m s. m. (9554/4). PS, AH, BF, PP, 2.9.2005.
- Slovenia and Austria, Kamniške Alpe/Steiner Alpen: Jezersko sedlo/Seeländer Sattel – Velika Baba, 1950-2127 m s. m. (9653/1). PS, BF, PP, 31.8.2005.

- Austria, Steiner Alpen: Vellacher Kotschna/Belska Kočna below Offnerhütte, 970-1469 m s. m. (9653/1). AH, 31.8.2005.
- Austria, Steiner Alpen: SSW of Matkosattel/Matkovo sedlo, 1650-1730 m s. m. (9653/2). ES, 31.8.2005.
- Slovenia, Kamniške Alpe: Logarski kot - waterfall Rinka - Frischaufov dom na Okrešlju, 1020-1400 m s. m. (9653/2). ES, 1.9.2005.
- Slovenia, Kamniške Alpe: Kamniško sedlo - Planjava - Lučka Brana (Baba) - Škarje, 1850-2392 m s. m. (9653/2). PS, BF, PP, 1.9.2005.
- Slovenia, Kamniške Alpe: Škarje - summit area of Ojstrica, 2100-2350 m s. m. (9653/2). SL, 1.9.2005.
- Slovenia, Kamniške Alpe: Sedelce – foot of Veliki vrh, 1840-1900 m s. m. (9654/1). SL, 2.9.2005.

New for the easternmost part of the Karawanken/Karavanke; first accurately localised records for the Kamniške Alpe. The two species of the *A. bellidifolia* (or *pumila*) aggregate, the tetraploid *A. bellidifolia* Cr. (= *A. pumila* Jacq.) s. str. and the diploid *A. stellulata* (Titz 1974), are easily distinguished by inspection of the indumentum of the basal leafs (furcate vs. stellate), and they differ also ecologically. *Arabis bellidifolia* is tetraploid, possibly originated after hybridisation between *A. soyeri* and *A. stellulata* (Titz & Weigerstorfer 1976), but Wraber (in Martinčič et al. 1999) treats it at the subspecific level (sub *A. pumila* Jacq. subsp. *pumila*). Jogan et al. (2001) list only two quadrants (Snežnik and Govci areas) for *A. stellulata*, in spite of the wide distribution (Julijske Alpe, Karavanke, Kamniške Alpe, Snežnik) given for this taxon by Wraber (in Martinčič et al. 1999) and of ca. 8-10 Slovenian herbarium records roughly mapped for Julijske Alpe and Kamniške Alpe by Titz (1974). The first precise locality for *A. stellulata* in Slovenia (Orlejci-Zeleni rob) was published by Dakskobler (1998). N. Jogan reports it also for Srednji vrh in western Karavanke (9449/3; floristic database of the Centre for Cartography of Fauna and Flora). While both species have been recorded from the Austrian side of the Karawanken from Obir and Košuta westwards (*A. stellulata* more often than *A. bellidifolia*; Hartl et al. 1992, and unpublished data of »Mapping the Flora of Austria«), no records exist for the easternmost part of the Karavanke, and no precisely localised records for the Kamniške Alpe. So far, beside the two map symbols in Julijske Alpe given by Titz & Weigerstorfer, exact localities of *A. bellidifolia* s. str. have not been published in Slovenia; Jogan et al. (2001) show only the map of *A. bellidifolia* including *A. stellulata*. Our records indicate that also in Slovenia, similar to the situation in Austria, *A. stellulata* seems to be far more frequent than *A. bellidifolia*, and both should be searched for more specifically.

Complementarily, we report on recent – exclusively Austrian – records of ***A. bellidifolia*** **Cr. s. str.**; most of these refer to quadrants new in comparison with Hartl et al. (1992):

- Austria, Karawanken: Wauchza/Bavhca – Korpitscher Alm/Grpiška planina – Korpitschgraben/Grpiški graben (SSW of Fürnitz/Brnca), 740-1540 m s. m. (9448/4). ES, 9.7.2003.
- Austria, Karawanken: northern slope WNW of Schwarzkogel/Kresišče (SSE of Altfinckenstein/Stari Bekštanj), 1450-1720 m s. m. (9449/3). LSE, SL, ES, 6.7.2003.
- Austria, Karawanken: northeastern slope of Mittagskogel/Kepa, 1850-1950 m s. m., limestone scree. (9449/4). ThE, 22. 9. 1993; LSE, 8.7.2003.
- Austria, Karawanken: Gratschenitzengraben/Gračenica near Rosenbach/Področica, 650-820 m s. m. (9450/3). HN, SL, 9.7.2003.
- Austria, Karawanken: quadrant Zell-Pfarre/Sele-Fara (9552/1). LSE, 1983 (included already in Hartl et al. 1992).
- Austria, Karawanken: northern slope of Koschuta/Košuta, e. g. between the saddles S of Mejnik and S of Wilze/Vilce, 1480-1790 m s. m. (9552/3). HN, 22.8.1981; LSE, 1983; LSE & T. Wraber, 1.8.1992 (included already in Hartl et al. 1992).
- Austria, Karawanken: Reschounikturm/Režovnikovo poldne (SSE of Zell-Schaida/Sele-Šajda), 1420-1500 m s. m. (9552/2). HN, SL, 3.9.2005.
- Austria, Steiner Alpen: Vellacher Kotschna/Belska Kočna below Offnerhütte, 970-1469 m s. m. (9653/1). AH, 31.8.2005.

***Carex ornithopodoides* Hausm.**

- Austria, Karawanken: northeastern slope of Mittagskogel/Kepa, 1850-1950 m s. m. (9449/4). ThE, 22. 9. 1993; LSE, 8.7.2003.
- Slovenia, Karavanke: cirque east of Stol summit, 1850 m s. m. (9551/3). ThE, 24.9.1993.
- Slovenia, Kamniške Alpe: Jezersko sedlo – Velika Baba, 1950-2127 m s. m. (9653/1). PS, BF, PP, 31.8.2005.
- Slovenia, Kamniške Alpe: Planjava, 2200-2392 m s. m. (9653/2). PS, BF, PP, 1.9.2005.

Second and third records for the Kamniške Alpe, second and third records for the Karawanken. While *Carex ornithopodoides* is treated at subspecific rank by Martinčič (in Martinčič et al. 1999), floras from other Alpine countries (e.g. Heß et al. 1967, Fischer 2005) rank it at specific level. It is most easily distinguished from *C. ornithopoda* Willd. by its glabrous utricles. Although *C. ornithopodoides* was already reported by Hayek (1907) from

Ojstrica in the Kamniške Alpe, it is only listed for the Julijske Alpe by Martinčič (in Martinčič et al. 1999). Jogan et al. (2001) present only a map of the *C. ornithopoda* aggregate. However, there are seven localities from three quadrants published for the Julijske Alpe by Wraber (1969). From the Austrian side of the Karawanken, only a single locality near Koschutnikurm/Košutnikov turn (LSE, 1983; quadrant presented in Hartl et al. 1992) had previously been known.

***Carex rupestris* All.**

- Slovenia, Kamniške Alpe: Raduha, SW ridge of Lanež, ca. 1850-1925 m s. m. (9554/4). PS, AH, BF, PP, 2.9.2005.
- Slovenia, Kamniške Alpe: Raduha, summit area, ca. 2000-2062 m s. m. (9554/3). PS, AH, BF, 2.9.2005.
- Slovenia, Kamniške Alpe: Storžič, SE ridge, ca. 2100 m s. m. (9652/3, in immediate vicinity to 9652/1). PS, BF, 10.6.2006 (LJU).
- Austria, Karawanken: SW ridge of Hochobir (Ojstrc), ca. 2030 m s. m. (9552/2). SL, HN, 31.8.2005.

New for the Kamniške Alpe, third record for the Karawanken. The arctic-alpine *C. rupestris* is an often overlooked inconspicuous sedge of exposed mountain crests (Wraber 1985) growing on limestone as well as on basic siliceous substrate. In the southeastern Alps, it was only known from the Julijske Alpe and Karavanke (Koschuta/Košuta and Petzen/Peca: L. Schratt-Ehrendorfer resp. H. Melzer in Hartl et al. 1992, Wraber 1993), but until now there have been no records of its occurrence in the Kamniške Alpe. We have found large stands on the summit crest of Velika Raduha and on nearby Lanež, as well as on the southeast ridge of Storžič. Its occurrence on the most peripheral peaks of the Kamniške Alpe strongly suggests that it is present also on the main chain of this mountain range.

***Draba dubia* Suter**

- Slovenia, Kamniške Alpe: W ridge of Velika Zelenica (ENE above Molička planina), 2020-2100 m s. m. (9653/2). SL, 2.9.2005 (WU).
- Slovenia, Kamniške Alpe: Raduha, between Durce and Lanež, ca. 1900 m s. m. (9554/4). PS, AH, BF, PP, 2.9.2005 (BOZ).

New for the Kamniške Alpe (third and fourth record for Slovenia). *Draba dubia* differs from *D. tomentosa* Clairv., which is far more frequent in the southeastern Alps mainly in shape and indumentum of the fruits ($\pm$ acute on both ends and glabrous on the surface in *D. dubia* vs. elliptic and stellate hairy in *D. tomentosa*; Buttler 1967). Whereas *D. tomentosa* is a characteristic species of exposed, rather high-alpine limestone crests, *D. dubia* occurs mainly on basic siliceous substrate in the Central Alps (for Carinthia, see Hartl et al. 1992). Consequently, *D. dubia* is very rare in the southeastern Alps, from where it has been recorded only from the Julijske Alpe (two localities; Wraber 1983) and from Dobratsch (Gailtaler Alpen; Hartl et al. 1992).

***Oxytropis neglecta* Ten.**

- Slovenia and Austria, Kamniške Alpe/Steiner Alpen: Jezersko sedlo/Seeländer Sattel – Velika Baba, on both sides of the border, 1950-2127 m s. m. (9653/1). PS, BF, PP, 31.8.2005.
- Slovenia, Kamniške Alpe: Kamniško sedlo - Planjava - Lučka Brana (Baba) - Škarje, 1850-2392 m s. m. (9653/2). PS, BF, PP, 1.9.2005; confirm. W. Gutermann.
- Austria and Slovenia, Karawanken/Karavanke: Mlinzasattel/Sedlo Mlinca - Frauenkogel/Baba, 1580-1892 m s. m. (9549/2). A. Tribsch, 6.7.2003.
- Austria, Karawanken: Schwalbenwand/Koprivnjak, 1750-1820 m s. m. (9550/1). PS, 6.7.2003.

There seems to be confusion about the Slovenian *Oxytropis*. Whereas the second edition of Mala flora Slovenije (Martinčič in Martinčič & Sušnik 1984) includes only *O. neglecta* (sub *O. pyrenaica* Godr. et Gren.), Martinčič (in Martinčič et al. 1999) in the third edition without comment lists only *O. montana* (L.) DC. s. str. (sub *O. jacquinii* Bunge) and gives the same distribution range. Consequently, Jogan et al. (2001) present only a map of *O. montana* s. str. (again sub *O. jacquinii*).

In their revision of the European taxa of *Oxytropis* sect. *Oxytropis*, Gutermann & Merxmüller (1961) have seen specimens of *O. × carinthiaca* Fisch.-Oost. (*O. montana* s. str. × *O. neglecta*) from the Karavanke (Golica/Kahlkogel, Bodental/Poden – Bärental/Medvedji dol) and the Kamniške Alpe (Korošica) as well as from the Julijske Alpe (Travnik, Triglav). Furthermore, they cite numerous localities for *O. neglecta* (sub *O. pyrenaica*) from the Karavanke, Kamniške and Julijske Alpe as well as from Snežnik, whereas *O. montana* s. str. is not reported for this region (the nearest locality listed by these authors being Dobratsch in Gailtaler Alpen, Austria). The two records of *O. montana* s. str. presented by Hartl et al. (1992) for the Austrian side of the Karawanken (Hochstuhl/Stol group and Obir) remain to be checked; nevertheless, this species, which is widespread in many other parts of the Alps, should also be critically looked for in Slovenia. Whereas the hybrid origin of *O. × carinthiaca* implies that its determination is fairly difficult, *O. montana* s. str. and *O. neglecta* can be distinguished by the length of the carpophor (as long or longer than the calyx tube vs. half as long), the length of the calyx teeth (c. ¼ as long as the calyx tube vs. usually >½ as long) and the indumentum of the scape, i.e. flowering stem (hairs bent upwards vs. conspicuously patent). *Oxytropis neglecta* is normally rosulate with reduced basal internodes whereas in *O. montana* s. str. the basal internodes are usually elongated (Gutermann & Merxmüller 1961).

Our data confirm the presence of *O. neglecta* in the Slovenian and the Austrian parts of the Kamniške Alpe/Steiner Alpen, as well as in the Austrian part and on the border ridge of the Karawanken/Karavanke, and add new localities to those quoted by Gutermann & Merxmüller (1961) and by Hartl et al. (1992).

Complementarily, we report on new records of the hybridogenous ***Oxytropis × carinthiaca* Fisch.-Oost.:**

- Austria and Slovenia, Karawanken/Karavanke: between Bärensattel/Medvedjak and the main ridge 1,3 km WNW of Wainasch/Vajnež, on both sides of the border, 1700-1950 m s. m. (9550/2). GMS, 11.7.2003.
- Austria, Karawanken: main ridge of Wainasch/Vajnež, 1950-2104 m s. m. (9550/4). GMS, 11.7.2003.
- A further observation that probably also refers to this taxon (from the Austrian side of Uschowa/Olševa, 9554/1) still needs confirmation on the basis of more suitable material.

***Pedicularis rosea* Wulfen**

- Slovenia, Kamniške Alpe: northern slopes of Velika Raduha, ca. 1700 m s. m. (9554/3). PS, AH, BF, 2.9.2005.
- Austria, Karawanken: Mittagkogel/Kepa, 2050-2145 m s. m. (9449/4). LSE, 8.7.2003 (confirmation of historical records).
- Austria, Karawanken: Bärentaler Kotschna/Struška, 1750-1944 m s. m. (9550/2). GMS, 9.7.2003 (confirmation of a historical record).
- Austria, Karawanken: W ridge to summit of Loibler Baba/Košutica, 1800-1969 m s. m. (9551/4). PS & A. Tribsch, 5.7.2003 (confirmation of a historical record).
- Austria, Karawanken: northern slope of Kleiner Grintoutz/Virnikov Grintovec, 1420 m s. m. (9552/4). PS, BF, 3.9.2005.
- Austria, Karawanken: Wackendorfer Spitze/Veška kopa (Petzen/Peca), 2000-2100 m s. m. (9454/3). SL, BF, ES, 29.8.2005.

New for Raduha, additional records and recent confirmations for the Karawanken. This alpine species has a continuous distribution in the southeastern Alps from the Julijske Alpe over the Karavanke to the Kamniške Alpe (Jogan et al. 2001, Hartl et al. 1992), but it has not yet been published for Raduha (Jogan et al. 2001). However, there is a herbarium specimen from Raduha deposited in LJU (leg. L. Godicl, LJU 10040879). The occurrence in humid rock crevices at the base of the northern rock face of Kleiner Grintoutz (Virnikov Grintovec) is worth mentioning because of the low altitude and the exceptional ecology, given that *P. rosea* is a taxon characteristic for windexposed Caricion firmæ (Aichinger 1933). An even lower locality (1200 m s. m.) is known from the scree base of the northern slope of Begunjščica (T. Wraber, pers. com.). Altogether, on the Austrian side of the Karawanken, where the map by Hartl et al. (1992) shows recent records only for four quadrants, occurrences in five more quadrants are confirmed or newly recorded.

***Salix serpillifolia* Scop.**

- Slovenia, Kamniške Alpe: ridge between Velika Raduha and Durce, ca. 1900-2062 m s. m. (9554/3). PS, AH, BF, 2.9.2005.
- Slovenia, Kamniške Alpe: Raduha, between Durce and Lanež, ca. 1780-1925 m s. m. (9554/4). PS, AH, BF, PP, 2.9.2005.

- Slovenia, Kamniške Alpe: Jezersko sedlo – Velika Baba, 1950-2127 m s. m. (9653/1). PS, BF, PP, 31.8.2005.
- Slovenia, Kamniške Alpe: Planjava 2200-2392 m s. m. (9653/2). PS, BF, PP, 1.9.2005.

New localities for the Kamniške Alpe. Within the southeastern Alps, this dwarf alpine willow is fairly common in the Julijske Alpe and rare in the Karavanke/Karawanken (Hartl et al. 1992, Jogan et al. 2001). In the Kamniške Alpe, it has only been known from the central parts (Kočna to Planjava) and from Krvavec (Hayek 1907, Haderlapp 1982). The record from quadrant 9755/2 in Jogan et al. (2001) is most probably erroneous, since the area does not exceed 1077 m above sea level. It is based on a floristic record by M. Wraber and has possibly been confused with *S. retusa* L.

We have found *S. serpillifolia* on Raduha as well as between Jezersko sedlo and Baba, suggesting that it is more common in the Kamniške Alpe than previously thought.

***Veronica fruticulosa* L.**

- Slovenia, Kamniške Alpe: between Koča v Grohotu (beneath Raduha) and the path-crossing 0.5 km WNW below Durce, ca. 1460-1620 m s. m. (9554/3). PS, AH, BF, 2.9.2005.
- Austria, Karawanken: below Bärensattel/Medvedjak, 1600-1690 m s. m. (9550/2). GMS, 11.7.2003.

New for Raduha, third record for the Karawanken. *Veronica fruticulosa* is a species of calcareous subalpine and alpine stony meadows and rock crevices, distributed throughout most of the Alps (Aeschimann et al. 2004). In the southeastern Alps it is common in the Julijske Alpe (Jogan et al. 2001) and rare in the Karavanke/Karawanken (Jogan et al. 2001, Hartl et al. 1992). From the Kamniške Alpe it was only reported by Hayek (1907) from the northern side of Kamniško sedlo in Slovenia and from around Vellach/Bela in Austria. We recorded it on the northern slope of Raduha on large, sunny rocks above Koča v Grohotu. *Veronica fruticulosa* could be mistaken with *V. fruticans* Jacq. when not in flower, but the former has glandular pubescent peduncles and calyces, whereas the latter lacks glandular hairs.

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Distribution of palpigrades (Arachnida, Palpigradi) in Slovenia with a new record of *Eukoenenia austriaca* (Hansen, 1926)

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Abstract. So far, three species of the palpigrade genus *Eukoenenia* have been found in Slovenia, predominantly in caves in the southern parts of the country: *Eukoenenia austriaca* (Hansen, 1926), *E. spelaea* (Peyerimhoff, 1902) and *E. gasparoi* Condé, 1988. Distributional map of the species mentioned is provided. In 2005, a subadult male of *E. austriaca* was collected in Migutovo brezno Cave, which is the first palpigrade record from the northwestern part of Slovenia. It was found on the surface of a small puddle in clay sediment deposited on the rocks of a narrow channel about 100 m from the cave entrance and about 15 m below the surface. Based on opisthosomal chaetotaxy, it differs from the nominal subspecies, and additional specimens from the locality would be required for exact subspecific determination. Microhabitats inhabited by palpigrades and collecting methods used are discussed.

Key words: Palpigradi, *Eukoenenia*, Slovenia, caves, distribution

Izvleček. RAZŠIRJENOST PALPIGRADOV (ARACHNIDA, PALPIGRADI) IN NOVA NAJDBA VRSTE *Eukoenenia austriaca* (HANSEN, 1926) V SLOVENIJI – V Sloveniji so bile predvsem v jamah južnega dela države odkrite tri vrste palpigradov: *Eukoenenia austriaca* (Hansen, 1926), *E. spelaea* (Peyerimhoff, 1902) in *E. gasparoi* Condé, 1988. V prispevku je prikazana karta njihove razširjenosti. Leta 2005 je bil v jami Migutovo brezno pri Škofji Loki najden osebek vrste *E. austriaca*, kar je prvi podatek za severozahodno Slovenijo. Pobran je bil z gladine majhne luže v ilovici v ozkem rovu, približno 100 m od jamskega vhoda in 15 m pod površjem. Po odlačenosti opistosome se razlikuje od nominalne podvrste, za natančnejšo določitev pa je treba nabrati dodaten material. Obravnavani so tudi mikrohabitati, ki jih naseljujejo palpigradi, ter metode zbiranja teh živali.

Ključne besede: Palpigradi, *Eukoenenia*, Slovenija, jame, razširjenost

Introduction

Palpigrades (Palpigradi) were described in 1885 as the last order within the class Arachnida. The animals are of small size (body length 1 – 2.5 mm), eyeless, whitish-translucent, with three-segmented chelicerae, leg-like pedipalps, antenniform first legs and a long flagellum at the end of opisthosoma (Condé 1996). 79 species have been known, classified in two families: Eukoeneniidae Petrunkevitch, 1955, and Prokoeneniidae Condé, 1996. Only members of the former family occur in Europe. Palpigrades are primarily distributed in the tropics, where they are soil inhabitants (Condé 1996). In Europe, only two species are endogean, while others have been found mostly in caves (Christian 2004), or in the terrestrial interstitial (Condé 1996, Christian 1998). The subterranean species are larger compared to their endogean counterparts. In the caves of Mallorca, *Eukoenenia draco* (Peyerimhoff, 1906) was discovered as the largest known palpigrade with the body length 2.8 mm (Condé 1984a).

All known localities of the *Eukoenenia* species in Slovenia and in its close vicinity of the neighbouring countries are given in Fig. 1. The first record of a palpigrade from Slovenia has been published by Hansen (1926). He described a new species, *Eukoenenia austriaca* (sub *Koenenia austriaca*) from Divaška Cave near Divača (Cadastre No. 741), and also reported on a second locality, Lukova jama pri Zdihovem Cave near Kočevje (Cad. No. 91). The literature source and both localities were cited by Wolf (1934-1938) under the name *Koenenia grassa* Hansen, 1926. The species was later registered also in Postojnska jama Cave (Cad. No. 747) (Juberthie-Jupeau 1963) and in some caves of the Italian Karst near Slovenian border (Condé 1989). Novak et al. (1981) trapped two specimens of *E. cf. austriaca* in Predjama Cave (Cad. No. 734), however, their subspecific status is unclear. Only nominal subspecies has been reported from Slovenia so far (Hansen 1926, Condé & Neuherz 1977). Condé & Neuherz (1977) provided further data on morphology of *E. a. austriaca* based on specimen from Postojnska jama Cave for comparison with subspecies that they described, *E. a. styriaca* Condé & Neuherz, 1977. The latter was discovered in Raudner Cave in Styria (Austria). Another subspecies, *E. a. stinyi* Strouhal, 1936, was described from the Eggerloch Cave near Villach in Austria (Condé 1972). Besides Carinthia, it was also found in artificial cavities near Verona in Italy (Condé 1984b). It is not synonymized with *E. a. styriaca*, even though Condé (1984) and Christian (2004) discussed this possibility. The subspecies *E. a. peregrina* Condé, 1989 was found in caves of Lombardia and Veneto provinces in Italy.

Eukoenenia spelaea (Peyerimhoff, 1902) is the second species known in Slovenia. Condé (1976) reported on it from the entrance of Mačkovica Cave near Laze pri Planini (Cad. No. 52), but without defining its subspecific status. In addition to the nominal form, three other subspecies are known: *E. spelaea vagvoelgyii* (Szalay, 1956) from several caves in northern Hungary, *E. s. strouhali* Condé, 1972 from Austria and *E. s. hauseri* Condé, 1974 from Ostrvička pečina Cave near Gospić in Croatia. The latter was also reported from Jama treh bratov Cave (Cad. No. 141) in Slovenia and from Grotta delle Perle Cave located in the Italian Karst near Trieste (Condé 1988).

The third species of the genus, *Eukoenenia gasparoi* Condé, 1988, was described from Grotta delle Perle Cave in Italy. It was also found in the Slovenian Karst, in Vilenica Cave near Sežana (Cad. No. 737) (Condé 1988).

These are the only records of palpigrades from Slovenia that were identified to the species or subspecies level. Novak (pers. comm., unpublished data) found *Eukoenenia* sp. individuals in the Pilanca Cave (Cad. No. 520) at least five times in the same place during several years. He is listing *Eukoenenia* sp. as being part of the cave fauna of the north and north-eastern part of the country, without specifying any exact localities (Novak 2005).

New record of *Eukoenenia austriaca* (Hansen, 1926)

The palpigrade specimen of *E. austriaca* was collected in the Migutovo brezno Cave (Cad. No. 5) situated close to Škofja Loka in northwestern Slovenia (Fig. 1). The cave is mainly of Tertiary conglomerate, and it is only its short southern channel right behind the entrance that was created in bedded cherty Triassic limestone (Kiauta & Leben 1960). The small entrance of the cave (0.5 x 1.5 m) opens in the middle of the meadow and continues into a gallery of larger dimensions. The main passage turns toward the north (Kiauta & Leben 1960) and after about 60 m ends in a small crevice explored in 1988, when continuation of the cave was discovered (Simić 1990). The ancient meanders of the narrow stream, situated at the lowest cave level, are connected with the neighbouring Marijino brezno Cave (Cad. No. 6) through small cracks (Pintar, pers. comm.). The palpigrade specimen was collected on 24th Dec 2005 by M. Zagmajster on the surface of a small puddle in clay sediment, deposited on the rocks of this narrow meander. This is about 100 m from the cave entrance and 15 m below the ground. Despite being carefully picked up, the flagellum was damaged, which often happens

in these fragile animals (Condé 1996). The palpigrade was fixed in 70% ethanol and put into permanent slide (Swann medium) for identification in phase-contrast microscope. Later on, it was identified by Ľ. Kováč. The specimen is stored in the Zoological Collection, Department of Biology, Biotechnical Faculty of University in Ljubljana (Slovenia).

The specimen from Migutovo brezno Cave belongs to the group of species with 2 + 2 thick setae (a1 and a2) on opisthosomal sternites IV-VI (Condé 1974). Presence of 3 lobes in lateral organ of prosoma classifies the specimen to *E. austriaca* (Hansen, 1926). It is a subadult male (form C), an intermediate stage between juvenile (form A) and male adult. Presence of seta t2 (second of the three dorsal axial setae) on the opisthosomal tergites III-VII is of subspecific importance: it is missing in the nominal subspecies, while being present in the other three subspecies (Condé 1989). In the specimen from Migutovo brezno Cave, seta t2 is present, thus it apparently does not belong to the nominal form. For further identification to the subspecies level, adult specimens from the locality are necessary to be studied.

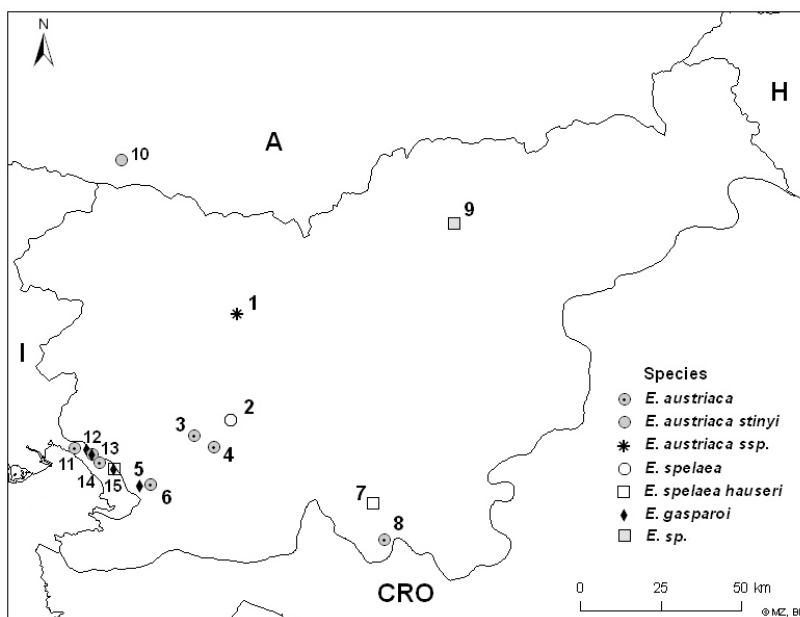


Figure 1. Localities of the *Eukoeneria* species in caves in Slovenia and its vicinity. Cave numbers: SLO: 1 – Migutovo brezno, 2 – Mačkovica, 3 – Predjama, 4 – Postojnska jama, 5 – Vilenica, 6 – Divaška jama, 7 – Jama treh bratov pri Kočevju, 8 – Lukova jama pri Zdihovem, 9 – Pilanca; A: 10 – Eggerloch near Villach; ITA: 11 – Grotta di Visogliano, 12 – Caverna III del M. Sedlen, 13 – Grotta Azzura di Samatorza, 14 – Grotta Ercole near Sgonic, 15 – Grotta delle Perle.

Slika 1. Najdišča vrst *Eukoeneria* sp. v jamah Slovenije in njene bližnje okolice. Oznake jam: SLO: 1 – Migutovo brezno, 2 – Mačkovica, 3 – Predjama, 4 – Postojnska jama, 5 – Vilenica, 6 – Divaška jama, 7 – Jama treh bratov pri Kočevju, 8 – Lukova jama pri Zdihovem, 9 – Pilanca; A: 10 – Eggerloch near Villach; ITA: 11 – Grotta di Visogliano, 12 – Caverna III del M. Sedlen, 13 – Grotta Azzura di Samatorza, 14 – Grotta Ercole near Sgonic, 15 – Grotta delle Perle.

Discussion

Palpigrades are small arachnids that are easily overlooked in caves, if not systematically searched for. In our case, the discovery of the specimen was accidental.

The animals live in different underground microhabitats, where they need high humidity (Christian 2004). Specimens may be discovered by careful visual inspections, as carried out during the investigations in Slovak and Hungarian caves (Kováč et al. 2002). Many representatives of *E. spelaea* were found under stones, on rotten wood, in clay sediment or on the surface of small water pools. In Slovenia, a palpigrade found under stone was reported from the entrance of Mačkovica Cave (Condé 1976). Individuals were collected on the surface of water pools in Postojnska jama Cave (Juberthie – Jupeau 1963), Pilanca Cave (Novak, pers. comm.) and in the Migutovo brezno Cave. In Pilanca Cave, specimens were observed on the same temporary water puddle in subsequent years at least five times (Novak, pers. comm.). The occurrence of palpigrades on water surface is most likely accidental, being fixed there as the cuticle does not permit water (Condé 1996). Perhaps they use the situation to forage on prey that fell on the water surface. This is the assumption only, since the foraging strategies and the diet of the palpigrades are still completely unknown (Condé 1996, Kováč et al. 2002, Christian 2004). In spite of the very fragile body, they may be also collected from the surface of standing water by planktonic net (Kováč et al. 2002). They may be even successfully extracted from the bottom sediment rich in organic material, as was shown in the study of *E. spelaea* in the Ardovska Cave in Slovakia (Kováč et al. 2002) using modified high-gradient apparatus (Crossley & Blair 1991) for soil microarthropods.

Some studies show that palpigrades can be collected using pitfall traps (Loksa 1961, Bajomi 1969). In Slovenia, two specimens were caught by such traps in Predjama Cave (Novak et al. 1981).

Taxonomy of Central European palpigrades (*E. austriaca* and *E. spelaea*) has not been resolved, and some authors even put in doubt the reliability of characters discriminating the two species (Christian 2004). Descriptions of some subspecies are based on one individual only, without considering the variation in distinguishing characters (Christian 2004). For this reason, the subspecific determination was avoided in the study of the *E. spelaea* species in Slovakia (Kováč et al. 2002). Additional uncertainty to some subspecific descriptions is given with scarce distribution data, which sometimes imply sympatric distribution. Two subspecies *E. austriaca stinyi* and *E. austriaca peregrina* dwelling in the underground cavities near Verona

(Condé 1984b, 1989) may serve as an example of the latter. In Slovenia, three *Eukoenenia* species were discovered, while the subspecific determination of the specimens is rare. The discovery in Migutovo brezno Cave is the first published indication that another subspecies of *E. austriaca* besides the nominal subspecies inhabits the Slovenian caves.

Povzetek

Palpigradi so drobni brezbarvni pajkovci, brez oči, s tričlenskimi helicerami, nogam podobnimi pedipalpi, podaljšanim prvim parom nog s tipalno funkcijo in z dolgim terminalnim bičem na opistosomi (Condé 1996). V Evropi žive le predstavniki družine Eukoeneriidae (Condé 1996), kjer so bili najdeni večinoma v jamah (Christian 2004) pa tudi v kopnem intersticiu (Condé 1996, Christian 1998).

Prvi je palpigrade v Sloveniji odkril Hansen (1926), ki je opisal novo vrsto *Eukoenenia austriaca* (kot *Koenenia austriaca*) iz Divaške jame. Vrsto je našel tudi v Lukovi jami pri Zdihovem (Hansen 1926), kasneje pa je bila odkrita še v Postojnski jami (Juberthie- Jupeau 1963). Novak et al. (1981) iz Predjame navajajo *E. cf. austriaca*. Poleg nominalne so bile pri *E. austriaca* (Hansen, 1926) opisane še tri podvrste, ki pa še niso bile najdene v Sloveniji. *E. austriaca styriaca* Condé & Neuherz, 1977 je opisana iz jame Raudner na avstrijskem Štajerskem. *E. a. stinyi* Strouhal, 1936 je znana iz jame Eggerloch blizu Beljaka v Avstriji (Condé 1972) in umetnih votlin blizu Verone v Italiji (Condé 1984b). Ti dve podvrsti nista sinonimizirani, čeprav Condé (1984b) in Christian (2004) obravnavata to možnost. Četrta, *E. a. peregrina* Condé, 1989, je znana iz jam v Italiji.

E. spelaea (Peyerimhoff, 1902) je druga vrsta palpigrada v Sloveniji, ki je bila odkrita na vhodu jame Mačkova pri Planini, brez določitve podvrste (Condé 1976). Poleg nominalne so sicer znane še tri podvrste: *E. spelaea vagvoelgyii* iz jam severne Madžarske, *E. s. strouhali* Condé, 1972 iz Avstrije in *E. s. hauseri* Condé, 1974 iz jame Ostrvička pečina pri Gospiću na Hrvaškem. Slednja je bila najdena tudi v Sloveniji (Jama treh bratov pri Kočevju) in v jami Grotta delle Perle na Tržaškem krasu v Italiji (Condé 1988).

Iz prav te jame v Italiji je bila opisana vrsta *E. gasparoi* Condé, 1988, ki je bila pri nas odkrita v jami Vilenici (Condé 1988).

Novak (ustno, neobj. podatki) je vsaj petkrat v več letih našel palpigrada *Eukoenenia* sp. v jami Pilanca. Avtor navaja vrsto *Eukoenenia* sp. kot del favne jam severne in severovzhodne Slovenije, a brez konkretnih nahajališč (Novak 2005).

Osebek, ki je bil decembra 2005 najden v jami Migutovo brezno pri Škofji Loki, pripada vrsti *E. austriaca*. Najden je bil na površini majhne luže na ilovici, v ozkih meandrirajočih kanalih jame, približno 100 m od jamskega vhoda in 15 m pod površjem. Gre za subadultnega samca (oblika C), kar je vmesna oblika med juvenilno (oblika A) in odraslo obliko. Obstoj set

t2 (drugih od treh hrbtnih aksialnih set) na opistosomalnih tergutih III – VII je značilna za vse podvrste, razen za nominalno (Condé 1989). Glede na to, da te sete osebek iz Migutovega brezna ima, ta gotovo ne pripada nominalni podvrsti. Natančnejša določitev pa ni mogoča, za to bo treba najti dodatne osebkke.

Palpigradi so drobne živali, ki jih z nenačrtnim iskanjem težko opazimo. Živali živijo v različnih podzemnih mikrohabitatih z visoko vlažnostjo (Christian 2004). Osebkke lahko najdemo s pozornim vizualnim pregledovanjem. V študiji v slovaških in madžarskih jamah so mnoge osebkke našli pod kamni, pod lesom, na ilovici in na gladini luž (Kováč et al. 2002). V Sloveniji je bil pod kamnom najden osebek na vhodu v jamo Mačkovico (Condé 1976), na vodni gladini pa osebkki iz Postojnske jame (Juberthie – Jupeau 1963), Pilance (Novak, ustno, neobj. podatki) in Migutovega brezna. Kljub krhkemu telesu pa jih lahko z vodne gladine pobereмо tudi s planktonsko mrežico (Kováč et al. 2002). V raziskavah slovaške jame Ardovská se je za zelo uspešno pri vzorčenju palpigradov izkazalo tudi izločanje iz organsko bogatega sedimenta (Kováč et al. 2002). Palpigrade pa je mogoče dobiti tudi v pasti (Loksa 1961, Bajomi 1969), kot sta bila ujeta osebkka v Predjami (Novak et al. 1981).

Taksonomija srednjeevropskih palpigradov je nerazrešena, nekateri avtorji pa celo dvomijo o razlikovanju vrst *E. austriaca* in *E. spelaea* (Christian 2004). Mnoge podvrste so opisane le na enem primerku, pri čemer morebitna variabilnost razločevalnih znakov ni upoštevana (Christian 2004). Dvom o obstoju podvrst včasih nakazujejo sicer redki podatki o razširjenosti, ki ponekod nakazujejo njihovo simpatrično pojavljanje. Tak primer sta *E. austriaca stinyi* in *E. austriaca peregrina* iz podzemnih votlin v okolici Verone (Condé 1984b, 1989). V Sloveniji so določitve do nivoja podvrst redke. Najdba v Migutovem breznu je prvi podatek, da se v državi pojavlja tudi druga podvrsta *E. austriaca* kot nominalna.

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Netopirji v prezimovališčih v Beli krajini pozimi 2001-2002

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Izvleček. V prispevku predstavljamo rezultate popisa prezimujočih netopirjev v jamah Bele krajine med decembrom 2001 in marcem 2002. Med pregledi 23 jam smo opazili štiri vrste: *Rhinolophus hipposideros*, *R. ferrumequinum*, *R. euryale* in *Myotis emarginatus*. Število prezimujočih *R. hipposideros* v jamah nižinske Bele krajine sva ocenili na približno 40 osebkov, število *R. ferrumequinum* pa na približno 10 osebkov.

Ključne besede: netopirji, prezimovanje, jame, razširjenost, podkovnjaki, ocena številčnosti populacije

Abstract. BATS IN HIBERNACULA OF BELA KRAJINA (SOUTHEASTERN SLOVENIA) IN THE WINTER OF 2001-2002. In this contribution, the results of a survey of hibernating bats in the caves of Bela krajina (Southeastern Slovenia) conducted between December 2001 and March 2002 are presented. During the survey of 23 caves, four species were observed: *Rhinolophus hipposideros*, *R. ferrumequinum*, *R. euryale* and *Myotis emarginatus*. The numbers of hibernating horseshoe bats in the caves of lowland Bela krajina were estimated at approximately 40 for *R. hipposideros* and close to 10 for *R. ferrumequinum*.

Key words: Chiroptera, hibernation, caves, distribution, *Rhinolophus*, population estimates

Uvod

Ocene biodiverzitetnih indeksov in drugih mer sestave življenjskih združb temeljijo na dveh osnovnih parametrih: na številnosti vrst (absolutnega števila ali gostote osebkov) in na skupnem številu vrst (Conroy & Nicholas 1996). Absolutno število osebkov posamezne vrste je pomembno tudi za spremljanje stanja vrste na nekem območju in le dobri osnovni podatki omogočajo primerjavo med različnimi leti (JNCC 1998, BCT 2001). Pri netopirjih je že sama ocena števila vrst precej težavna in je vanjo treba vložiti precej napora (npr. Presetnik et al. in print). Absolutne ocene števila osebkov posameznih vrst netopirjev pa so za Slovenijo redke in podane le za vso državo, medtem ko je očitno, da so vrste v nekaterih regijah pogostejše kot drugih (Presetnik et al. in print).

Mali podkovnjak je v Sloveniji, še posebno na kraških območjih, splošno razširjena vrsta in je v zatočiščih lahko opazen (Presetnik et al. in print), zato so povod za zimski monitoring netopirjev v prezimovališčih v Beli krajini dali rezultati raziskav poletnega raziskovalnega tabora študentov biologije Semič 2001 (Presetnik 2002). Takrat v devetih raziskovalnih dneh s pregledi potencialnih zatočišč v nižinskih predelih Bele krajine pod 300 m nadmorske višine nismo našli nobene kolonije ali posameznih osebkov malega podkovnjaka (Sl. 1) in le en osebek smo zaznali z ultrazvočnimi detektorji v prehranjevalnem habitatu. Vrsto pa smo pogostejše opazili na višjih predelih (pobočja Kočevske planote) in v zgornji dolini reke Kolpe. Podobno maloštevilne, z izjemo majhne porodniške kolonije v Novi Lipi, so bile tudi najdbe malih podkovnjakov v južnem delu Bele krajine poleti 2002 (Presetnik et al. in print). Tudi literaturni podatki o malih podkovnjakih v Beli krajini so skopi. V letu 1979 so porodniško kolonijo našli v zapuščeni hiši v Bojancih, leto kasneje pa v Damlju (Kryštufek 1982). Hudoklin (1994) in Kryštufek & Hudoklin (1999) za jame nižinskih predelov Bele krajine navajata le posamezne primerke prezimujočih malih podkovnjakov (Tab. 1).

Maloštevilnost najdb preseneča, saj bi lahko glede na primernost prehranjevalnih habitatov in potencialnih poletnih zatočišč v belokranjski kotlini pričakovali večjo pogostost te vrste, kakršna je značilna za osrednjo Slovenijo.

Mali podkovnjak prezimuje v jamah, zato smo hoteli s pregledom čim večjega števila jam oceniti velikost zimske populacije v Beli krajini. Ker je vrsta sedentarna (Hutterer et al. 2005) in med poletnimi ter zimskimi zatočišči navadno preletava kratke razdalje (Roer & Schober 2001), smo majhno število osebkov pričakovali tudi pri zimskem štetju.

Namen raziskave je bil ugotoviti številnost prezimujočih netopirjev v jamah Bele krajine in temperaturne razmere v zatočiščih, ter rezultate predstaviti na način, ki bi omogočal primerjavo z drugimi regijami.

Material in metode

Območje nižinske Bele krajine (Perko et al. 1998) obravnavamo kot območje, ki ga na jugu in vzhodu omejuje reka Kolpa, na severu in zahodu pa ga navidezno omejuje izohipsa za 300 m nadmorske višine na pobočjih Gorjancev, njihovem veznem goratem nadaljevanju do Kočevskega roba ter na pobočjih Poljanske gore (Sl. 1). Pri prvem jezu pod zaselkom Kot 1 km južno od Damlja meja prečka dolino Kolpe (Sl. 1).

Obravnavano območje je veliko 339,4 km². V nižinski Beli krajini prevladuje nizki kras, ki določa tudi prevladujoči tip tamkajšnjih jam. Jame so večinoma kratke, pogosto izvirne oziroma s tekočo vodo. Večina jam je vodoravnih, kar je razlog, da so večinoma lahko dostopne, le nekatere imajo globlja vhodna ali notranja brezna.

Jame smo pregledovali od konca decembra 2001 do marca 2002. V raziskavi smo se omejili na sedem UTM-kvadratov (WL15, WL 25, WL 04, WL 14, WL 24, WL13, WL23; Sl. 1). Netopirji potrebujejo med zimskim spanjem stalne razmere – nizko, vendar ne prenizko temperaturo in visoko zračno vlago (Schober & Grimmberger 1989). Zato nismo pregledovali jam, za katere smo pričakovali, da netopirji v njih nimajo primernih razmer za prezimovanje. Mednje smo šteli jame krajše od 15 m in jame pri katerih je bilo razmerje med dolžino in globino manjše od 1,4, s čimer smo izločili brezna. Pri pregledih smo uporabljali čelne in ročne halogenske svetilke. Letajočim osebkom netopirjev smo vrsto določili s heterodinim ultrazvočnim detektorjem Pettersson D200. Temperaturo smo merili z elektronskim termometrom 1 m nad tlemi jame čim dlje od jamskega vhoda. Nekajkrat smo izmerili tudi temperaturo tik ob netopirjih - bližje od 5 cm (Tab. 1).

Rezultati in razprava

Opažene vrste netopirjev

Pregledali smo 23 jam, 17 od teh na območju nižinske Bele krajine (sl. 1). V njih smo našli štiri vrste prezimujočih netopirjev: malega (*Rhinolophus hipposideros*), velikega (*R. ferrumequinum*) in južnega podkovnjaka (*R. euryale*) ter vejicatega netopirja (*Myotis emarginatus*) (Tab. 1). Našli smo še skeletne ostanke navadnega/ostrouhega netopirja (*Myotis myotis/blythii*) (Tab. 1).

Tabela 1. Seznam pregledanih jam Bele krajine in v njih najdenih vrst netopirjev pozimi 2001/02, skupaj s predhodnimi opažanji tam prezimujočih netopirjev.

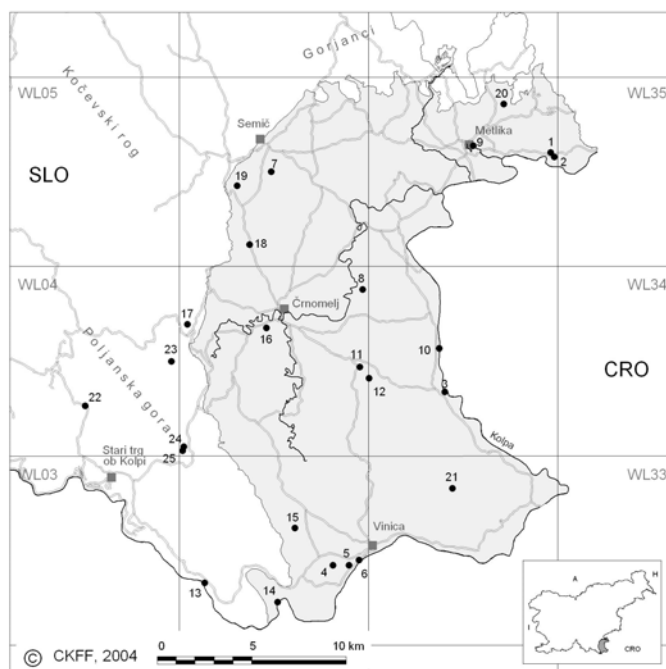
(oznake vrst: *Rf* – *Rhinolophus ferrumequinum*, *Rh* – *R. hipposideros*, *Re* – *R. euryale*, *Mem* – *Myotis emarginatus*, *Mmyo/bl* – *M. myotis/blythii*, 0 – ni bilo netopirjev; v oklepaju za oznako vrst je število opaženih osebkov); (*) – temperatura, izmerjena manj kot 5 cm od netopirja; Literatura: ⁽¹⁾ Hudoklin (1994), ⁽²⁾ Kryštufek (1992), ⁽³⁾ Kryštufek & Hudoklin (1999))

Table 1. List of caves surveyed and bat species recorded therein in Bela krajina in the winter of 2001/02, together with the previously published records of hibernating bats.

(species code: *Rf* – *Rhinolophus ferrumequinum*, *Rh* – *R. hipposideros*, *Re* – *R. euryale*, *Mem* – *Myotis emarginatus*, *Mmyo/bl* – *M. myotis/blythii*, 0 – bats not present; number of bats observed is given in brackets behind the species code; (*) – temperature less than 5 cm from a bat; literature data: ⁽¹⁾ Hudoklin (1994), ⁽²⁾ Kryštufek (1992), ⁽³⁾ Kryštufek & Hudoklin (1999))

Št. lok./ No. loc	Jama (katastrska št.)/ Cave (cave register No.)	Datum/ Date	T [C°]	Prepoznane vrste/ Recognized species	Predhodne najdbe/ Previous finds ^(1, 2, 3)
1	Božakova jama (2059)	29.12.01	10,2	<i>Rh</i> (2)	-
2	Vidovec (3342)	29.12.01	9,9	<i>Rh</i> (1), <i>Rf</i> (1)	<i>Rh</i> (1) ^(1, 3)
3	Dolenjski zdenec (1800)	29.12.01	4,1	0	0 ^(1, 3)
4	Mali zjot (1270)	29.12.01	/	0	0 ^(1, 3)
5	Velike Džot (1818)	29.12.01	/	<i>Mmyo/bl</i> - skeletni ostanke / bone remains	0 ^(1, 3)
6	Jama v kamnolomu (2950)	29.12.01	7,9*	<i>Rh</i> (1)*	<i>Rh</i> (8) ⁽¹⁾ <i>Rh</i> (1) ^(1, 3)
7	Malikovec (2316)	29.12.01	0,5	<i>Rh</i> (1)	<i>Rf</i> (1) ^(1, 3)
8	Jelenja jama (1796)	5.1.02	5,9	<i>Rh</i> (5), <i>Mem</i> (1), <i>Rf</i> -skeletni ostanke / bone remains	-
9	Jama pri Metliki (1275)	5.1.02	12,0	0	-
10	Zdenec v Dragoših (3194)	5.1.02	/	vhod zasut / entrance blocked	-
11	Rian (1266)	5.1.02	/	poplavljen/ flooded	-
12	Hajdučka jama (1801)	5.1.02	9,8	<i>Rf</i> (1)	<i>Rf</i> , <i>Rh</i> ⁽²⁾
13	Kobiljača (1281)	13.1.02	9,2	0	0 ^(1, 3)

Št. lok./ No. loc	Jama (katastrska št.)/ Cave (cave register No.)	Datum/ Date	T [C°]	Prepoznane vrste/ Recognized species	Predhodne najdbe/ Previous finds ^(1, 2, 3)
14	Lapič (1271)	13.1.02	/	<i>Mmyo/bl</i> - skeletni ostanki / bone remains	-
15	Lesina (1811)	13.1.02	9,7	0	-
		1.4.02	/	<i>Rf</i> (2)	
16	Gadina (235)	26.1.02	10,2*	<i>Rh</i> (2)*	-
17	Mali Zjot (236)	26.1.02	1,2	0	-
18	Stobe (1404)	26.1.02	8,9	0	-
19	Jama dobrega pajka (6676)	26.1.02	9,2*	<i>Rh</i> (1)*	-
20	Bečka jama (6275)	15.2.02	10,7	<i>Rh</i> (4), <i>Rf</i> (1)	-
21	Petrišina jama (3426)	24.2.02	9,7	<i>Re</i> (26)	-
			9,0*	<i>Rf</i> (1)*	
22	Andrejčkov štibelec (1263)	26.1.02	8,7	0	-
23	Grdanji skedenj (831)	26.1.02	3,2	0	-
24	Frnikola (3158)	15.2.02	6,5	<i>Rh</i> (8), <i>Rf</i> (2)	-
25	Slobodanova jama (3162)	15.2.02	4,9	<i>Rh</i> (1)	-



Slika 1. Jame, pregledane v zimi 2001/02 (Osenčeno je območje nižinske Bele krajine in označene so lokacije iz Tab. 1).

Figure 1. Caves surveyed in the winter of 2001/02 (Lowland Bela krajina area is shaded and locations from Tab. 1 are marked).

Prezimujoče netopirje smo zasledili v 10 jamah. Po opaženih vrstah in številu osebkov so naši rezultati zelo podobni predhodnim opažanjem (Kryštufek 1992, Hudoklin 1994 in Kryštufek & Hudoklin 1999; Tab. 1). Netopirjev nismo opazili v jamah krajših od 40 m (lokacije številka 3, 4, 5, 9, 14, 18; Tab.1) in v jamah z velikim vhodom (št. 17, 23.; Tab.1), ki verjetno nimajo ustrezne mikroklima. Nepričakovano pa sredi zime netopirjev niso našli v dokaj veliki in razgibani jami Lesina (št. 15; Tab. 1) z ozkim vhodom in s primerno mikroklimo.

Ocena števila prezimujočih malih in velikih podkovnjakov v nižinski Beli krajini

Od 26 opaženih malih podkovnjakov smo jih devet (34 %) našli v dveh jamah, ki jih ne uvrščamo v nižinsko Belo krajino (št. 24, 25; Tab. 1). Druge male podkovnjake smo našli v osmih jamah na nadmorski višini od 140 do 230 m (Tab. 1). V štirih jamah nižinske Bele krajine smo zabeležili štiri izmed šestih opaženih velikih podkovnjakov. V nižinski Beli krajini je bilo razmerje med prezimujočimi velikimi podkovnjaki in malimi podkovnjaki 1 : 4,25.

Odsotnost netopirjev v krajših jamah podpira osnovno predpostavko, da v jamah, krajših od 15 m, ni pričakovati večjega števila prezimujočih netopirjev. Zato smo pri oceni števila možnih prezimovališč upoštevali osnovne predpostavke (glej poglavje Material in metode), dodatno pa smo na podlagi naših rezultatov kot neprimerne za prezimovanje podkovnjakov izločili še vse jame, ki so bile krajše od 30 m (Tab. 2).

Tabela 2. Raziskanost jamskih prezimovališč podkovnjakov v nižinski Beli krajini.

Table 2. Extent of the survey of the horseshoe bats' cave hibernacula in lowland Bela krajina.

Št. znanih jam / No. of known caves	107
Ocenjeno št. možnih prezimovališč / Estimated No. of potential cave hibernacula	21
Št. (odstotek) pregledanih potencialnih prezimovališč / No. (percentage) of surveyed potential cave hibernacula	13 (62%)

Po takšnih kriterijih smo v pregledanih 62 % možnih jamskih prezimovališč podkovnjakov v nižinski Beli krajini (Tab. 2) našli le 17 malih podkovnjakov. Zato ocenjujemo, da je jame nižinske Bele krajine v zimi 2001/02 skupno uporabljalo približno 40 malih podkovnjakov.

Na enak način ocenjujemo, da je v jamah nižinske Bele krajine prezimovalo približno 10 velikih podkovnjakov. Vendar je ta ocena manj natančna kot ocena števila malih podkovnjakov. Vzrok za to je različna prezimovalna ekologija obeh vrst, ker se veliki podkovnjaki v nasprotju z malimi med prezimovanjem pogosto združujejo v večje gručice (Kryštufek & Hudoklin 1999, Presetnik & Bergant 2002). Zato bi lahko novo odkritje ene same takšne skupine močno vplivalo na oceno števila velikih podkovnjakov.

Ocene števila prezimujočih podkovnjakov veljajo le za naravne jame. Del populacij malih in velikih podkovnjakov v nižinski Beli krajini bi lahko prezimoval tudi v primernih umetnih podzemnih habitatih, kot so npr. neogrevane kleti in rovi rudnikov, vendar teh zaradi težav pri odkrivanju in ocenjevanju njihovega skupnega števila nismo pregledovali.

V skladu z našimi pričakovanji zimska populacija malega podkovnjaka v nižinski Beli krajini ni številna - le približno 1 osebek na 20 km² oz. 1 osebek na 1,24 jame, ocenjene kot primerne za prezimovanje (Tab. 2). Povprečna temperatura jam, v katerih so prezimovali mali podkovnjaki ($9,0 \pm 1,7$ °C; $N = 7$), je bila višja od optimalne temperature za prezimovanje (med 6 in 8 °C), kot jo navajata Roer & Schober (2001). V nižinski Beli krajini je v primerjavi s podobno velikim ozemljem Kočevskega Roga in Poljsanske gore po naši oceni (glej Material in metode) tudi za več kot polovico manj primernih jam za prezimovanje. Vse to bi lahko vplivalo na redkost malih podkovnjakov v nižinski Beli krajini, vendar bi za potrditev te hipoteze morali pridobiti ustrezne podatke o številu prezimujočih netopirjev in o temperaturah v jamah Kočevskega Roga ter Poljsanske gore.

Mali podkovnjaki lahko za kotišča uporabljajo tudi podstrehe zidanic ali opuščeni hiš, ki jih med poletji 2001 in 2002 skoraj nismo pregledovali. Dodatne porodniške kolonije malih podkovnjakov zato pričakujeva tudi v nižinski Beli krajini predvsem v njenem zahodnem delu, ki je bližji jamam Kočevskega Roga in Poljsanske gore.

Nova kolonija južnih podkovnjakov

V Petrišini jami (št. 21; Tab. 1, Sl. 1) smo našli doslej še nepoznano prezimovališče južnih podkovnjakov. Jama leži približno na sredi med doslej poznanimi pomladnimi in poletnimi zatočišči posameznih osebkov južnih podkovnjakov v Dolenjskem zdencu, Bezgovki (Kryštufek 1984), v Jami v kamnolomu (Kryštufek 1992) in v Božakovi jami (Hudoklin 1994). V končni – Podorni dvorani Petrišine jame smo opazili 26 omotičnih ali budnih osebkov, posamezni južni podkovnjaki pa so že letali med našim vstopom v dvorano, na tleh so bile večje količine

starega in novega gvana. Že prvi raziskovalci jame so v njej pred več kot 30 leti videli gruče njim neznanih netopirjev (domnevno podkovnjakov) in gvano (P. Klepec, ustno). Od takrat se je okolica jame popolnoma spremenila iz travnika v gost gozd, očitno pa je jama še vedno pomembna za netopirje. To pravzaprav ni presenetljivo, saj v tem delu Bele krajine jam ni veliko, troglofilne vrste, kot so podkovnjaki, pa jih potrebujejo za svoje preživetje.

Zahvala

Klemen Koselj je močno pripomogel k jasnosti teksta. Pregledi pa ne bi bili izpeljani brez pomoči Boštjana Vrviščarja in Mojce Zazula Vrviščar (Jamarski klub Železničar), Martine Bergant in Mateja Dularja (Društvo za raziskovanje jam Ljubljana). Petru Klepcu in Alojziju Kocjanu (BJK Črnomelj) se zahvaljujemo za pomoč pri iskanju jam in dodatne informacije o jamah. Pri pregledih so sodelovali še Nina Aupič, Vesna Cafuta in Luka Kremžar. Društvo študentov biologije je posodilo del opreme.

Summary

Rhinolophus hipposideros is a common species in Slovenia, especially in karst areas. Relatively conspicuous roosting habits make horseshoe bats particularly suitable for population census. Summer bat studies by Presetnik (2002) and Presetnik et al. (in print) in lowland Bela krajina (Southeastern Slovenia) revealed a surprisingly low number of *R. hipposideros*. In order to confirm low abundance of this species in the area, a survey of caves was conducted in the winter of 2001/2002. Since *R. hipposideros* is a relatively sedentary species, we expected the winter population of a similar size as the summer population.

In 23 caves (Tab 1, Fig. 1), four hibernating bat species were found: *Rhinolophus hipposideros*, *R. ferrumequinum*, *R. euryale* and *Myotis emarginatus*, along with individual bone remains of *M. myotis/blythii*. Bats were not found in short caves or caves with large entrances, probably due to the unsuitable microclimate. On the basis of this result, an estimate of the number of potential horseshoe bat hibernacula in natural caves was made using the following criteria: caves shorter than 30 m and caves with length - depth ratio lower than 1.4 (eliminating shafts) were omitted (Tab. 2). According to these criteria, we surveyed 62% of potential horseshoe bat hibernacula and found 17 *R. hipposideros* and 4 *R. ferrumequinum* (Tab. 1). The ratio between the number of animals of *R. ferrumequinum* and *R. hipposideros* was 1 : 4.25.

We estimate that natural caves in lowland Bela krajina in the winter of 2001/2002 served as hibernacula for approximately 40 *R. hipposideros* and approximately 10 *R. ferrumequinum*. The overwintering *R. hipposideros* population density in lowland Bela krajina is approximately 1 specimen per 20 km², or 1 specimen per 1.24 potential cave hibernaculum. The reliability of the population estimates is slightly diminished, because potential hibernacula in artificial underground habitats (cellars or mines) were not included in the survey. However, the low winter abundance of *R. hipposideros* in lowland Bela krajina confirms the low summer abundance as revealed by previous summer surveys by Presetnik (2002) and Presetnik et al. (in print).

The survey also revealed a previously unknown hibernaculum of *R. euryale* (Tab.1), which harboured the biggest known congregation of this species in Bela krajina.

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M. Van Veen: Hoverflies of Northwestern Europe, Identification keys to the Syrphidae.

KNNV Publishing, Utrecht, 2004. ISBN: 90 5011 199 8

Approximately 250 species of hoverflies (Diptera: Syrphidae) have been found for Slovenia. However, the estimates for this group range between 400 and 500 species. So, still many species have to be discovered in Slovenia. When you start to deal with such a fascinating group, you soon face the problem of which identification literature should be taken into account.

Till recently, this problem could partially be solved only by making a reference collection, use the hoverfly guides of van der Goot (1981) or Bradescu, (1991) or compile your own key with the keys published in various articles. Especially the facts that guides were either in Dutch (van der Goot 1981) or French (Bradescu 1991), which makes it difficult to use these guides for non-native speakers, and that they were not up-to-date (recently there were many changes in taxonomy and new species for science were discovered), make them more or less problematic for use in the field. In 2004, M. van Veen published a possible answer to cope with this problem: A hoverfly key for Northwestern Europe.

The book starts with the preface where van Veen describes for which areas within Europe the key is useful: North-western Europe, which ranges from Scandinavia, Germany, North France and Ireland. The preface also provides the information that the females for some genera are not included as good identification criteria do not yet exist.

In the introductory part, he explains every basic detail about the family of hoverflies. He starts how this group can be distinguished from other relative similar insects like wasps, bees and bumblebees. This book also explains the habitats of different species. Actually you can find hoverflies everywhere where flowers are flowering. But most of the species are attracted to the fringes of forests, meadows and marshes. You will find especially the species with limited ability to disperse in the vicinity of the larval micro habitat, whereas good dispersers can be found everywhere. A flower-rich garden can already be a good place to start with hoverflies.

The largest part of the book covers the determination keys. In general, the keys bring you directly to the correct species, especially with beautiful illustrations, most of which are borrowed from Verlinden (1990). Before publishing, the keys were used by experts; however, in every publication one can find some mistakes. The corrections can be found on the internet site: <http://home.hccnet.nl/mp.van.veen/boekhoverflies.html>

When reading the title, bells should ring: how many of the Slovenian hoverflies can be actually identified by this book? The answer is that more than 80% of the species are included in the book. This is because the majority of the species occurring in Slovenia are Central European species that also occur in Northwestern Europe.

From all known genera in the region, three are not included: *Rohdendorfia*, *Spazigaster* and *Syrphocheilosia*. Although 80% of the species are included in the book, it can still be hard to determine them, as the missing species are scattered among the genera. The genera, which are mostly southern orientated (*Merodon*, *Eumerus*) or are very specialized and space limited (*Cheilosia*), or even whose status is more or less unknown (*Pipiza*, *Pipizella*, *Paragus*), are problematic. However, the book is very useful for the central and eastern parts of Slovenia. When you visit the Alps or the Mediterranean area, however, it is advisable to find additional keys.

In conclusion, although the keys are in general very useful for the territory of Slovenia, one should use it very carefully, and when there are anomalies it can happen that a species is not in the key at all. Therefore it should only be used as a basic key; together with additional keys and photo books, such as those by Reemer (2000).

Maarten de Groot

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NAVODILA AVTORJEM

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

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

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

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

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

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

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

FORMAT IN OBLIKA PRISPEVKA

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

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

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

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

SLIKE IN TABELE

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

NAVAJANJE LITERATURE

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

Primeri:

- članke iz revij citiramo:

Schultz J.W. (1987): The origin of the spinning apparatuses in spiders. *Biol. Rev.* 62: 123-134.

Parry D.A., Brown R.H.J. (1959): The hydraulic mechanism of the spider leg. *J. exp. Biol.* 36: 654-657.

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

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

Lucas S. (1988b): Spiders and their silks. *Discovery* 25: 1-4.

- knjige, poglavja iz knjig, poročila, kongresne povzetke citiramo:

Foelix R.F. (1996): *Biology of spiders*, 2. edition. Harvard University Press, London, pp. 155-162.

Nentwig W., Heimer S. (1987): *Ecological aspects of spider webs*. In: Nentwig W. (Ed.), *Ecophysiology of Spiders*. Springer Verlag, Berlin, 211 pp.

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

INSTRUCTIONS TO AUTHORS

NATURA SLOVENIAE publishes original papers in Slovene and English which contribute to the understanding of the natural history of Slovenia. Papers may be submitted as Scientific Papers, Short Communications or Field Notes.

Scientific Paper is a complete description of the original research including theoretical review, research area, methods, detailed presentation of the results obtained and discussion, conclusions and references. The length of the Scientific Paper may not exceed twenty pages.

Short Communication is an original paper without detailed theoretical review. Its purpose is to introduce partial or preliminary results of the research. The length of the Short Communication may not exceed five pages.

Field Note is a short report on interesting faunistic or botanical findings or observations in Slovenia. The length of the Field Note may not exceed three pages.

All papers will be subject to peer review by one referee. Authors are invited to suggest the names of referees, although the editor reserves the right to elect an alternative referee to those suggested. The reviewed paper should be corrected by author or authors themselves. In the case of the rejection, the original materials will be sent back to the corresponding author with the editors explanation.

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

Papers should be submitted to NATURA SLOVENIAE, Department of Biology, University of Ljubljana Večna pot 111, SI-1111 Ljubljana, Slovenia (telephone: +386 (0)1 423 33 88, fax: +386 (0)1 273 390, E-mail: rok.kostanjsek@bf.uni-lj.si).

FORMAT AND FORM OF ARTICLES

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

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

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

ILLUSTRATIONS AND TABLES

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

LITERATURE

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

Examples (use the the following forms):

- articles from journals:

Schultz J.W. (1987): The origin of the spinning apparatuses in spiders. *Biol. Rev.* 62: 123-134.

Parry D.A., Brown R.H.J. (1959): The hydraulic mechanism of the spider leg. *J. exp. Biol.* 36: 654-657.

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

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

Lucas S. (1988b): Spiders and their silks. *Discovery* 25: 1-4.

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

Foelix R.F. (1996): *Biology of spiders*, 2. edition. Harvard University Press, London, pp. 155-162.

Nentwig W., Heimer S. (1987): Ecological aspects of spider webs. In: Nentwig W. (Ed.), *Ecophysiology of Spiders*. Springer Verlag, Berlin, 211 pp.

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