

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

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Abstract. So far, three species of the palpigrade genus *Eukoeneria* have been found in Slovenia, predominantly in caves in the southern parts of the country: *Eukoeneria 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, *Eukoeneria*, Slovenia, caves, distribution

Izvleček. RAZŠIRJENOST PALPIGRADOV (ARACHNIDA, PALPIGRADI) IN NOVA NAJDBA VRSTE *Eukoeneria austriaca* (HANSEN, 1926) V SLOVENIJI – V Sloveniji so bile predvsem v jamah južnega dela države odkrite tri vrste palpigradov: *Eukoeneria 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. Pobrajen 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.

Gljučne besede: Palpigradi, *Eukoeneria*, 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: Eukoeneriidae Petrunkevitch, 1955, and Prokoeneriidae 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, *Eukoeneria draco* (Peyerimhoff, 1906) was discovered as the largest known palpigrade with the body length 2.8 mm (Condé 1984a).

All known localities of the *Eukoeneria* 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, *Eukoeneria austriaca* (sub *Koeneria 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 *Koeneria 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.

Eukoeneria spelaea (Peyerimhoff, 1902) is the second species known in Slovenia. Condé (1976) reported on it from the entrance of Mačkoviča 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, *Eukoeneria 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 *Eukoeneria* sp. individuals in the Pilanca Cave (Cad. No. 520) at least five times in the same place during several years. He is listing *Eukoeneria* 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 *Eukoeneria 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.

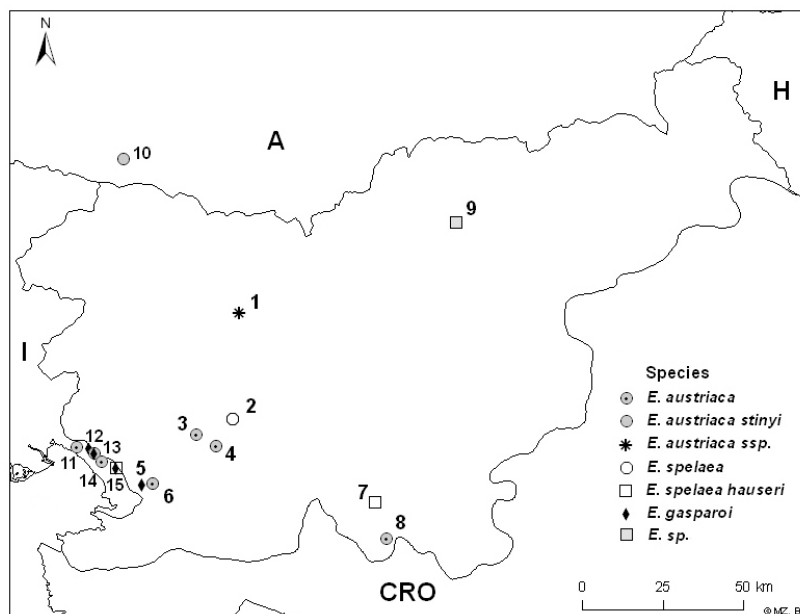


Figure 1. Localities of the *Eukoeneria* species in caves in Slovenia and its vicinity. Cave numbers: SLO: 1 – Migutovo brezno, 2 – Mačkovića, 3 – Predjama, 4 – Postojnska jama, 5 – Vilenica, 6 – Divaška jama, 7 – Jama treh bratov pri Kočevju, 8 – Lukova jama pri Zdihovem, 9 – Pilanca; A: 10 – Eggerloch 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 – Mačkovića, 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 Mačkoviča Cave (Condé 1976). Individuals were collected on the surface of water pools in Postojnska jama Cave (Juberthie – Jupeau 1963), Pilanča Cave (Novak, pers. comm.) and in the Migutovo brezno Cave. In Pilanča 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 intersticialu (Condé 1996, Christian 1998).

Prvi je palpigrada 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 Mačkovica 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 tergih 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 Mačkovo (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 poberejo 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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