Terrestrial Isopods (Isopoda: Oniscidea) from the Slovenian Karst

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Abstract. Hand sorting was performed in 28 habitats of the Slovenian Karst during 2004. Twenty-three terrestrial isopod species were identified, two of which proved to be new for the Slovenian fauna, namely *Trichoniscus matulici* and *Armadillidium nasatum*. Synanthropic and semi-natural sampling sites were chosen for collecting samples. The species *Orthometopon dalmatinum*, *Philoscia affinis, Protracheoniscus politus*, *Trachelipus ratzeburgii* were found to be common in semi natural sites, while *Androniscus roseus*, *Chaetophiloscia cellaria* and *Armadillidium vulgare* appeared frequently in synanthropic habitats. Previous investigations of the terrestrial isopod species distribution in the neighbouring northern Italian area showed higher species diversity than in Slovenian western area close to the Italian borderline. This is the reason why a higher terrestrial isopod species diversity is expected during further sampling experiments in Slovenian territory near the Italian border.

Keywords: woodlice, Slovenia, faunistics, distribution

Izvleček. KOPENSKI RAKI ENAKONOŽCI (ISOPODA: ONISCIDEA) NA OBMOČJU SLOVENSKEGA KRASA - V 28 različnih predelih slovenskega Krasa smo jeseni leta 2004 nabrali vzorce kopenskih rakov enakonožcev. V njih smo našli 23 različnih vrst, med njimi tudi dve za Slovenijo novi vrsti *Trichoniscus matulici* in *Armadillidium nasatum*. Vzorce smo nabirali tako v habitatih v bližini človeških bivališč kot v polnaravnih habitatih. Predstavnike vrst, kot so *Orthometopon dalmatinum*, *Philoscia affinis, Protracheoniscus politus*, *Trachelipus ratzeburgii*, smo našli bolj v naravnih okoljih, medtem ko so predstavniki vrst *Androniscus roseus*, *Chaetophiloscia cellaria* in *Armadillidium vulgare* kazali trend večje zastopanosti v bližini človeških bivališč. Rezultati predhodnih raziskav raziskovalcev na italijanskem teritoriju omenjenega predela Slovenije so pokazali precej večjo vrstno raznolikost kopenskih rakov enakonožcev, kot je to bilo ugotovljeno na slovenskem teritoriju. Ravno zaradi tega je v prihodnosti med natančnejšimi raziskavami pričakovati tudi večjo vrstno raznolikost na slovenskem teritoriju omenjenega predela Slovenije.

Ključne besede: raki enakonožci, Slovenija, Kras, favna, distribucija

Introduction

Several publications on terrestrial isopods of Slovenia have been published in the last decades (Karaman 1966, Potočnik 1979, Potočnik 1980). Prior to the present study, however, faunistic data from the Slovenian Karst were generally based on woodlice of troglobiont or troglophilous nature, or on species associated with streams in the environs of caves and less known on species sampled in surface habitats. Due to the peculiar water conditions, the Karst is mostly dry, especially during the summer period, which influences the species diversity and distribution over the area.

The unique geographical and geological characteristics of the landscape drove us to perform faunistic examinations in the area. Our aim was to detect terrestrial isopods in this particular environment and to collect specimens from as many habitats as possible, paying attention to the level of human perturbation and to vegetation coverage.

Materials and methods

Geographical and geological features

The Karst is located in the western part of Slovenia (Fig. 1), surrounded by the Julian Alps in the north and east, and the Dinarid mountains in the south and west. The western edge is identical to the political border between Slovenia and Italy.

The geomorphology and dynamics of the area are determined by the sedimentary bedrock characteristics. The porous texture of the Mesozoic limestone and dolomite-breccia causes the immediate oozing of water to the deeper regions of the sedimental layers. Dolines and other typical Karst formations develop as a result of this progress in the area. The lack of surface water causes a broad xeric environment along the Karst area indicated by xerophilous vegetation. Moreover, the area of the Karst is also influenced by the Adriatic clime with hot and dry summers followed by mild winters.

As there are no big cities in the Karst, the noticeably agricultural influences can be noticed in the landscape. Woodlands and shrubs form a diverse mosaic with pastures and vineyards. Nevertheless, rural woodlands are also located close to synanthropic sites.

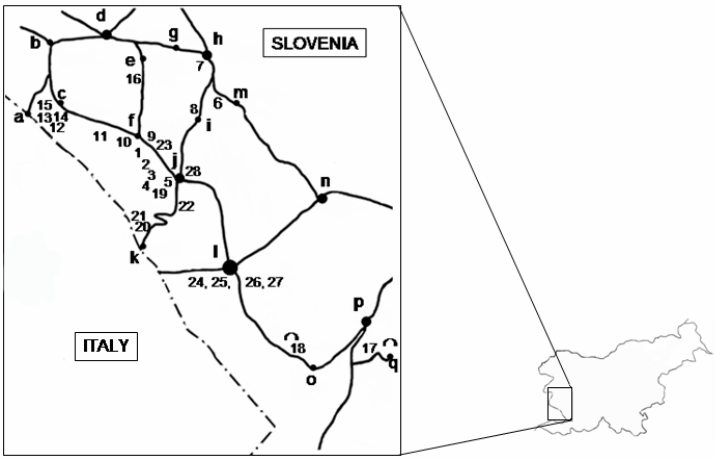

Figure 1: Map of examined area (a: Gorjansko/St. Belagio; b: Gorjansko; c: Brje pri Komnu; d: Komen; e: Gabrovica/Coljava; f: Pliskovica; g: Kobjeglava; h: Štanjel; i: Kopriva; j: Dutovlje; k: Repentabor/Monrupino; l: Sežana; m: Ponikve; n: Storje; o: Lokev; p: Divača; q: Matavun, with numbers representing localities shown in Table 1)
Slika 1: Zemljevid preiskovanega območja (a: Gorjansko/St. Belagio; b: Gorjansko; c: Brje pri Komnu; d: Komen; e: Gabrovica/Coljava; f: Pliskovica; g: Kobjeglava; h: Štanjel; i: Kopriva; j: Dutovlje; k: Repentabor/Monrupino; l: Sežana; m: Ponikve; n: Storje; o: Lokev; p: Divača; q: Matavun. Številke prikazujejo lokalitete prikazane v tabeli 1)

Habitats

Hand sorting was carried out in 13 semi-natural and 15 synanthropic habitats. Semi-natural sites are characterized by a high coverage of downy oak (*Quercus pubescens*) shrubs and woods, and Austrian pine (*Pinus nigra*) forests. Nevertheless, pine forests had a poor herb layer in contrast with the oak vegetation.

Habitats considered as synanthropic were parks, gardens, grasslands, orchards and pleated stone walls.

Sampling method

Terrestrial isopods were collected by hand sorting (Tab. 1) during October 2004. The sampling unit was about 30 minutes. Features of the sites (e.g. vegetation, coverage, soil parameters, humidity) were also recorded for further evaluations. Identification of species was

carried out with the help of the works by Strouhal (1939), Schmölzer (1965), Gruner (1966), Schmidt (1997) and Schmalfuss (unpubl.). The collected specimens were preserved in 70% ethanol and placed in the collection of University of Ljubljana (UL) and Szent István University, Budapest (SZIU). Nomenclature of species was used according to Schmalfuss (2003).

Table 1: Detailed list of sampling localities and their status of urbanization
Tabela 1: Seznam lokalitet z opisi in stopnjo urbanizacije

No.	Locality	Status	Vegetation, habitat	Elevation (m)	Altitude (E)	Latitude (N)	Date
1.	Pliskovica	A	monocot vegetation	239	13° 47'411"	45° 46'155"	13.10.2004.
2.	Pliskovica	N	downy oak forest	242	13° 48'170"	45° 45'467"	13.10.2004.
3.	Dutovlje	N	downy oak forest	255	13° 48'970"	45° 45'058"	13.10.2004.
4.	Dutovlje	N	pine forest	328	13° 49'103"	45° 44'796"	13.10.2004.
5.	Dutovlje	A	ruderal weeds, trash	271	13° 49'676"	45° 45'112"	13.10.2004.
6.	Ponikve	N	downy oak forest	285	13° 50'890"	45° 48'155"	14.10.2004.
7.	Stanjel	A	park with *Picea abies*	300	13° 50'892"	45° 49'402"	14.10.2004.
8.	Kopriva	N	disturbed pine forest	267	13° 50'032"	45° 47'144"	14.10.2004.
9.	Pliskovica	A	pleated stone wall	281	13° 49'372"	45° 46'307"	14.10.2004.
10.	Pliskovica	A	weeds and ornamental plants	252	13° 47'029"	45° 46'287"	14.10.2004.
11.	Pliskovica	N	downy oak forest	218	13° 45'983"	45° 46'229"	15.10.2004.
12.	Brje	N	downy oak forest	148	13° 46'685"	45° 46'685"	15.10.2004.
13.	Brje	N	downy oak forest	137	13° 42' 851"	45° 46'722"	15.10.2004.
14.	Brje	N	downy oak forest	244	13° 46' 540"	45° 46' 537"	15.10.2004.
15.	Brje	A	pleated stone wall	175	13° 42'853"	45° 46'704"	15.10.2004.
16.	Coljava	A	meadow	255	13° 46'840"	45° 47'993"	16.10.2004.
17.	Škocjan	N	downy oak forest	ND	ND	ND	16.10.2004.
18.	Jama Vilenica	N	downy oak forest	ND	ND	ND	16.10.2004.
19.	Dutovlje	A	black locust + *Rubus sp.*	272	13° 49'651"	45° 45'114"	17.10.2004.
20.	Mt.Prelovec	N	downy oak forest	326	13° 49'104"	45° 43'977"	17.10.2004.
21.	Mt.Prelovec	N	pine forest	420	13° 48'842"	45° 44'077"	17.10.2004.
22.	Kreplje	A	monocot plants, weeds	275	13° 49'870"	45° 44'554"	17.10.2004.
23.	Pliskovica – Krajna Vas	A	pleated stone wall	271	13° 47'518"	45° 46'350"	18.10.2004.
24.	Sežana	A	greenhouse	340	13° 52'487"	45° 42'416"	19.10.2004.
25.	Sežana	A	bot. garden	335	13° 52'505"	45° 42'647"	19.10.2004.
26.	Sežana	A	meadow	353	13° 52'437"	45° 42'707"	19.10.2004.
27.	Sežana	A	monocot plants, weeds	325	13° 49'974"	45° 45'355"	19.10.2004.
28.	Dutovlje	A	monocot plants	285	ND	ND	19.10.2004.

N = Semi-natural shrubs and woods; A = synanthropic sites (gardens, pastures, orchards, vineyards, stone walls); ND = data missing

Results

Faunistic data

Twenty-three species could be detected from the observed area (Tab. 2), of which the species *Trichoniscus matulici* Verhoeff, 1901 and *Armadillidium nasatum* Budde-Lund, 1885 proved to be new to the Slovenian fauna.

Table 2: List of species and their occurrence. Literature column indicates data of presence of species in examined area: a – data on sloveian species according to Potočnik (1979, 1980, 1993), b – data on Karst species according to Karaman (1966). The name of the collection site in the table indicates the collection site outside the Karst region.
Tabela 2: Seznam vrst in njihova zastopanost na preiskovanih lokalitetah. V koloni Vir oznaka 'a' ponazarja prisotnost vrst na celotnem ozemlju Slovenije po Potočnik (1979, 1980, 1993), oznaka 'b' pa prisotnost vrst na območju Krasa po Karaman (1966). V primeru, ko je nahajališče vrste v Sloveniji izven območja Krasa, je navedeno ime lokalitete.

No.	Species/Vrsta	Literature/Vir	Number of sites/Št. lokalitet
1.	*Titanethes sp.**	a, b	27
2.	*Trichoniscus matulici* Verhoeff 1901	/	12
3.	*Trichoniscus illyricus* Verhoeff, 1931	a Žirovski vrh	6, 11, 20
4.	*Androniscus roseus* (C. Koch, 1938)	a, b	1, 21, 22, 23, 25, 26
5.	*Haplophthalmus fiumaranus* Verhoeff, 1908	a Kočevje, b	4, 6, 8, 11, 12, 13, 14, 26
6.	*Haplophthalmus mengii* (Zaddach, 1844)	a	25
7.	*Chaetophiloscia cellaria* (Dollfus, 1884)	a, b	15, 23, 25
8.	*Philoscia affinis* Verhoeff, 1908	a	2, 3, 6, 12, 15, 16, 20, 22
9.	*Platyarthrus hoffmannseggii* Brandt, 1833	b Novo mesto	10, 14, 15, 16, 17, 26
10.	*Cylisticus convexus* (De Geer, 1778)	a	22
11.	*Porcellionides pruinosus* (Brandt, 1833)	a	5, 10, 19, 22, 23, 26
12.	*Orthometopon dalmatinum* (Verhoeff, 1901)	a	7, 8, 9, 10, 11, 13, 14, 15, 17, 18, 19, 23, 25, 26
13.	*Protraceoniscus politus* (C. Koch, 1841)	a	2, 3, 4, 6, 7, 8, 12, 13, 15, 16, 17, 20, 21, 23, 25
14.	*Trachelipus arcuatus* (Budde-Lund, 1885)	a, b	1, 12, 19
15.	*Trachelipus rathkii* (Brandt, 1833)	a, b	2
16.	*Trachelipus ratzeburgii* (Brandt, 1833)	a	1, 5, 12, 13, 14, 16, 17, 20, 21, 23, 25
17.	*Trachelipus camerani* (Tua, 1900)	a	7, 18, 23
18.	*Porcellio marginalis* Budde-Lund, 1885	a	15, 23
19.	*Porcellio scaber* Latreille, 1804	a	28
20.	*Porcellio spinicornis* Say, 1818	a	9, 22, 23
21.	*Armadillidium frontirostre* Budde-Lund, 1885	a, b	10
22.	*Armadillidium nasatum* Budde-Lund, 1885	/	5
23.	*Armadillidium vulgare* Latreille, 1804	a, b	9, 10, 14, 15, 16, 17, 26

* troglobiont species occurring on the surface

Trichoniscidae:

***Trichoniscus matulici* Verhoeff, 1901**

Syn.: *T. omblae*, *remyi*, *sorrentinus*, *stygivagus*, *turgidus*

Distinctive male pereiopodits and pleiopodids of *T. matulici* are shown on Fig. 2. The species has a known distribution in Bosnia and Herzegovina, Croatia, Serbia and Montenegro and southern Italy. The examined material originated from a dry downy oak forest close to the border between Slovenia and Italy (Scmalfuss 2003).

An additional appearance of the species is known from Kranjska Gora sampled by the students* of the University of Ljubljana.

Examined material: Brje, in leaf litter, 15. 10. 2004. leg. F., Vilisics, det. H., Schmalfuss (UL, SZIU); Sundeca Jama pri Podpeci, leg. Tabor Dragonja, det. H. Schmalfuss (UL).

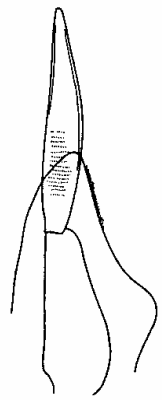

Figure 2a: Male 1st pleopodit of *Trichoniscus matulici* (Strouhal 1966)
Slika 2a: Prvi pleopodid samca *Trichoniscus matulici* (Strouhal 1966)

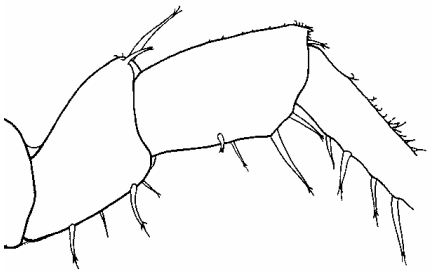

Figure 2b. Male 7th Pereiopodit of *Trichoniscus matulici* (Strouhal 1966)
Slika 2b: Sedmi pereopodid samca *Trichoniscus matulici* (Strouhal 1966)

Armadillidiidae:

***Armadillidium nasatum* Budde-Lund, 1885**

Syn.: *A. mehelyi, nasutum, quadrifrons, sorrentinum, speyeri*

Distinctive male pleiopodits and head of *A. nasatum* are shown on Fig. 3. The species has a wide distribution in Europe in the Mediterranean and Atlantic climate, but is also known from greenhouses of Finland, Scandinavia and Central Europe (Gruner 1966, Schmalfuss 2003), and introduced to North America (Schmalfuss, 2003). In addition to the European data, juvenile specimens found outdoor might be a signal of the species establishment outside of a greenhouse in Hungary (Vilisics, unpubl.).

The specimens in Slovenia were found in a synanthropic habitat under rubbish, wet cardboards and bricks. However, the species could not be found in the adjacent habitats. Interestingly, a high number of juveniles were detected from the sampling site, which proves that *A. nasatum* has a reproductive period in late fall in this region.

Examined material: Dutovlje, ruderal meadows, under rubbish and cardboards, leg. et det. F. Vilisics, 13. 10. 2004 (UL).

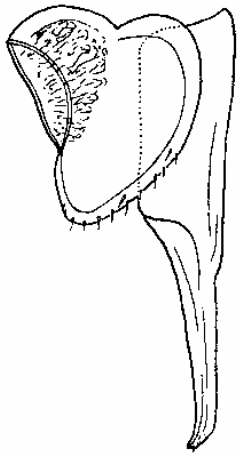

Figure 3a. Male 1st pleopodits of *Armadillidium nasatum* (Gruner 1966)

Figure 3a. Prvi pleopodid samca *Armadillidium nasatum* (Gruner 1966)

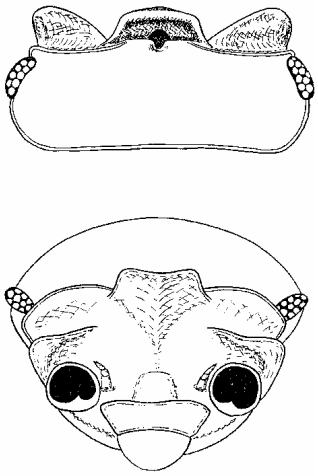

Figure 3b: Dorsal na frontal view of the head of *Armadillidium nasatum* (Gruner 1966)
Slika 3b: Glava *Armadillidium nasatum* (Gruner 1966)

Discussion

Twenty-three isopod species were found in the Slovenian Karst, which is approximately 35% of the known Isopoda fauna. The list contains two species new to the Slovenian fauna, namely *T. matulici* and *A. nasatum.*

The species list contains isopods typical to the region (e.g. *H. fiumaranus*, *O. dalmatinum Trachelipus camerani* (Tua, 1900)), one troglobiont isopod (*Titanethes* sp.), there are species with a wide Mediterranean distribution (*C. cellaria*, *A. frontirostre*), and also Central-Eastern European (*P. politus*) and European elements (*H. mengii*, *P. affinis*), and cosmopolitan species (*A. vulgare*, *P. pruinosus*). The troglobiont isopod *Titanethes sp*. was found under stones in the botanical garden of Sežana.

We suppose that the species *H. fiumaranus* and *P. affinis, O. dalmatinum, T. ratzeburgii, P. politus* are typical in the semi-natural habitats (dry oak woods and Austrian pine forests) of the Karst.

Pleated stone walls as ecotones are characteristic elements of the Karst and proved to be the richest in species, considering that 12 species were found in these habitats. Common species are *A. vulgare, P. spinicornis* and *P. marginatus*, but in the neighbourhood of settlements the species *C. cellaria* was also common. We suppose that relative richness in species might be caused by the suitable microclimate of stone walls that had an open exposure to the sun, thus woodlice remained active and detectable even in late October.

Since *A. nasatum* occurred in a local rubbish heap, we suppose that the species is able to reproduce under outdoor conditions and the species occurrence is assumable in various localities of Slovenia.

These basic faunistic data indicate that unique species composition might be found in the Karst due to its peculiar ecological characteristics and location. Nevertheless, comparing Slovenia with Italy, its western neighbour, a high contrast can be seen in the number of species. Approximately 80% of the examined species occur in the neighbouring Italy, too (Schmalfuss 2003), thus we believe that there is a high probability that new species will be recorded in Slovenia during further faunistic investigations.

Povzetek

Ker je predel slovenskega Krasa še precej neraziskan, kar zadeva vrstno raznolikost kopenskih rakov enakonožcev, smo jeseni leta 2004 nabrali vzorce v okoljih, kjer je vpliv človeka velik (pašniki, vinogradi, kompostniki), in v okoljih, kjer je človeški vpliv neznaten. Našli smo 23 vrst (približno 35 % vseh vrst, opisanih v Sloveniji), med njimi tudi vrsti *Trichoniscus matulici* in *Armadillidium nasatum*, ki sta novi za Slovenijo. Predstavniki vrste *T. matulici* so bili najdeni v habitatih, ki ni neposredno pod vplivom človeka, predstavniki vrste *A. nasatum* pa v sinantropnih habitatih. Poleg tega smo našli na površini predstavnike rodu Titanethes, za katere je znano, da so troglobiontski organizmi. Rezultati so pokazali, da ima favna rakov enakonožcev na področju Krasa tako vrste, ki so razširjene v mediteranskem področju, kot tudi predstavnike vrst, ki živijo v centralno-vzhodnem delu Evrope. Značilne vrste v naravnih okoljih so bile *Orthometopon dalmatinum*, *Philoscia affinis, Protracheoniscus politus*, *Trachelipus ratzeburgii*, v sinantropni asociaciji pa smo našli predstavnike vrst *Androniscus roseus*, *Chaetophiloscia cellaria* in *Armadillidium vulgare.*

Acknowledgements

We would like to thank Prof Dr Jasna Štrus for her selfless help, Dr Rok Kostanjšek for providing equipments for fieldwork and identification. Special appreciation is addressed to Dr Helmut Schmalfuss for his great help in taxonomic identification. The study tour to Slovenia was sponsored by the CEEPUS mobility grant No. 2004 – 2654 - CEEPUS; Network number: H-19.

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