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Inspection on materials contributing to the knowledge of terrestrial Isopoda (Crustacea, Oniscidea) in Finland

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Identifications of 226 terrestrial isopod samples mostly coming from the unidentified domestic material stored in the Finnish Museum of Natural History, and from our field surveys referred to the following species; *Hyloniscus riparius*, *Trichoniscus pusillus, Oniscus asellus, Porcellio dilatatus, P. spinicornis, P. scaber, Cylisticus convexus, Trachelipus rathkii, Armadillidium opacum, A. pictum, A. pulchellum, A. nasatum, A. vulgare* and *A. zenckeri.* Field populations of *A. vulgare* and *H. riparius* were recorded for the first time in Finland, while *T. rathkii* specimens from Lapua prove that isopods' distrubution reaches the Finnish inland. We also revisited the material donated to museum collections by the late Professor E. Palmén and we found old samples of *P. dilatatus* collected in greenhouses in Helsinki, Salo and Halikko and identified but not published by him. We also discuss the ranges of terrestrial Isopoda in Finland where they live at the northern margins of their distributions.

1. Introduction

Basic information on Finnish woodlice dates back to the 1940's and 1950's, when Ernst Palmén studied the fauna of terrestrial Isopoda in Finland. He reported several species new to the fauna (Palmén 1946a,b; Palmén 1947, 1948 and 1951) and some of them were published as samples donated to museum collections (Kalela 1946–47). Since those days only few additional information on Oniscidea has been published (Lehtinen 1961, 1962; Haahtela 1991). Lehtinen (1961) added the myrmecophilous *Platyarthrus hoffmannseggii* Brandt, 1833 as a species new to the fauna. Rassi *et al.* (2001) considered it to be a threatened species in Finland and due to the destruction of the only known locality it evidently has disappeared there. According to the check-list by Silfverberg (1999) 25 species of terrestrial Isopoda, including unintentionally introduced and indoor species primarily living in greenhouse, are recorded in Finland.

Many field samplings of soil invertebrates have been carried out in Finland since the days of Palmén and these have resulted among other individuals of terrestrial isopods. These isopods have been preserved as unidentified material for decades in the Invertebrate Division of Zoological Museum in the Finnish Museum of Natural History (FMNH). Here we present the results of identifications of samples in that meterial and we supplemented the material with field samplings in different parts of the country.

2. Materials and methods

Unidentified woodlice material in Zoological Museum, FMNH were keyed out during the summer

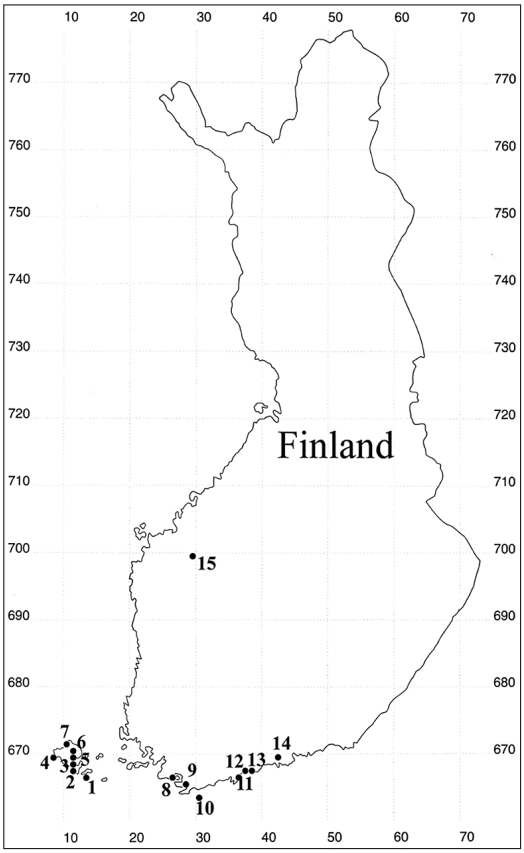


Fig. 1. The 10 × 10 km squares of the Finnish Uniform Grid (27oE) System for the sample sites of the species. Serials (1–15) refer to the species and the localities as indicated in Table 2.

of 2007 at Szent István University, Hungary. The majority of the material was stored in vials filled with 70% ethyl-alcohol, but there were 13 samples pinned up and labeled in paper boxes. Identification was carried out by the first author using morphological traits as key marks. We also reviseted some samples of the collection by E. Palmén in FMNH.

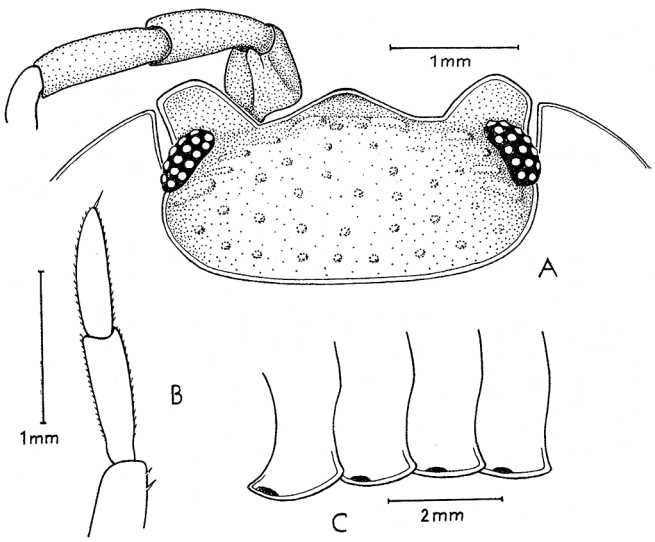
Besides identification of museum materials, we undertook field samplings in natural and synanthropic habitats in 2005–2007. This comprised 58 sites in different parts of Finland. Sample sites were located in the 10 × 10 km squares of the Finnish Uniform Grid System (Grid 27°) and the squares were given serials as indicated in Fig. 1. The individuals were collected by hand and 34 of the sites visited were devoid of isopods. In working out the study material identification keys and figures of Gruner (1966) and Schmölzer (1965) were used, and the nomenclature is according to Schmalfuss (2003).

3. Results

Identifications of the domestic terrestrial isopod material (226 samples, 1,613 specimens) stored in FMNH resulted 10 terrestrial isopod species (Table 1): *H. riparius, O. asellus, P. scaber, P. spinicornis, T. rathkii, A. nasatum, A. opacum, A. pictum, A. pulchellum, A. zenckeri*. The majority of the individuals belonged to two species namely *Porcellio scaber* Latreille, 1804 and *Trachelipus rathkii* (Brandt, 1833) contributing 47% and 29% of the total amount of specimens, respectively. The sampling record of these frequent species did not, however, indicate any noticeable populations contributing to the range already indicated in Palmén (1946a) and the same refers to *Porcellio spinicornis* Say, 1818. The latter species is a common European woodlouse also introduced to North America. Recently, we have found it to be among the most common species in the city area of Helsinki, also in comparison with *P. scaber*.

Table 1. Summary of the revisited and identified Isopoda samples stored in the Finnish Museum of Natural History.

Family	Species	Samples identified
Trichoniscidae		
1.	*Trichoniscus pusillus*	11
Cylisticidae		
2.	*Cylisticus convexus*	1
Porcellionidae		
3.	*Porcellio spinicornis*	15
4.	*Porcellio dilatatus*	5
5.	*Porcellio scaber*	106
Trachelipodidae		
6.	*Trachelipus rathkii*	65
Armadillidiidae		
7.	*Armadillidium pulchellum*	1
8.	*Armadillidium zenckeri*	1
9.	*Armadillidium pictum*	11
10.	*Armadillidium opacum*	10
		226



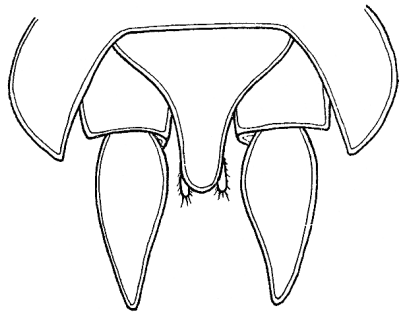


Fig. 2. – a (left). Morphology of head (A), flagellum (B) and tergites (C) of *Porcellio dilatatus* by Gruner (1966), pp. 265. – b (above). Morphology of the telson and uropods of *Porcellio dilatatus* by Gruner (1966), pp. 265.

Distribution data including museum material and field samplings to less frequent species are indicated on Table 2. Data of frequent species as *P. scaber, T. rathkii* stored in the Museum were so numerous that it exceeds the size of a manuscript.

The samples of the *P. dilatatus* in Finland show the presence of the species in the greenhouse Isopoda fauna of Finland. These samples are included in the material donated to the museum collections by Palmén (Kalela 1946–47) but we have not find any report on them in the papers by Palmén who, however assumed in his earlier paper (1946a) that the species may occur in greenhouses. We agree with his identifications but due to the considerable age of the samples only new records would firmly prove the occurrence of the species in Finland.

The overall shape of the species is wide oval, coloration ranges from dark grey to brown with lighter pattern. Overall appearance is wider compared to *P. scaber*. The front corners of the 1st pereonites are far beyond the eyes, reaching the side lobes of the head. Nodules on the head and peraeon extremely dense and strong, on the head and 1st pereonite in more or less regular cross lines. Front side of the head between the side lobes is more or less triangular, the angle of middle lobe is clearly rounded, side edges straight and the tip turns slightly upwards (Fig. 2a). Basal segment of flagellum is slightly longer than the distal one. Telson is more or less two times longer than its width, elongated triangle with a rounded tip (Fig. 2b).

This species is widely distributed in Europe, and it has been introduced in other parts of the world, like the Americas and Japan (e.g. Oliver & Meecham 1993; Schmalfuss 2003).

The records of *T. rathkii* show the species to be among the most common Oniscidea species in southern Finland including the Åland Islands. The sample sites of the museum material are only contributional to those indicated by Palmén (1946a) and they do not lie outside the range of the species shown in the latter reference. *T. rathkii* is widespread across Europe and introduced in other continents such as North America (Schmalfuss 2003).

Extensive field samplings in different parts of Finland yielded 11 isopod species: *H. riparius, T. pusillus, O. asellus, P. scaber, P. spinicornis, C. convexus, T. rathkii, A. nasatum, A. opacum, A. pulchellum* and *A. vulgare*.

Field samplings resulted new records of *T. rathkii* near the Lapua river in the vicinity of Lapua. These are among the northernmost localities of the species in Finland. Considering typical habitat types in Lapua (spruce-birch forests, farmlands and urban areas) *T. rathkii* occurred exclusively in the anthropogenic areas.

Considering the *Armadillidium* species (Table 2, Fig. 1), the outdoor sample of *A. vulgare* in Helsinki, Suomenlinna (May 2005), on an old frontier

Table 2. Data of the revisited and identified Isopoda samples stored in the Finnish Museum of Natural History and of isopods collected in field samplings. Museum data were omitted for frequent species: *O. asellus, P. scaber, P. spinicornis, T. rathkii*. Following the coordinates is given the collection localities (Fig. 1) in parentheses.

Species and source of data	Location	Site	Microhabitat	Coordinate	Date	Leg.	Det.
***Hyloniscus riparius* (C. Koch, 1838)**							
Museum material	Helsinki	Pakila	greenhouse	667:38(13)	4.6.1946	EP	FV
Field sampling	Helsinki	Krematoriontie	stone wall, stones	667:38(13)	4.7.2007	FV	FV
***Trichoniscus pusillus* Brandt, 1833**							
Field sampling	Porvoo	Kokonniemi, camping site	leaf litter, soil	669:42(14)	30.6.2007	FV	FV
***Oniscus asellus* Linnaeus, 1758**							
Field sampling	Helsinki	Suomenlinna	stones	666:36(12)	6-7.5.2005	FV	FV
	Helsinki	Korkeasaari, Zoo	stones, wood	667:38(13)	7.5.2005	FV	FV
	Helsinki	Tähtitorninmäki park	debris at the fence	667:38(13)	3.7.2007	FV	FV
	Helsinki	Kaivopuisto park I. “cliff” and “Ursa”	big stones	667:38(13)	4.7.2007	FV	FV
	Helsinki	Kaivopuisto park II	debris, stones	667:38(13)	4.7.2007	FV	FV
	Helsinki	Uspenski cathedral’s park I	stones	667:38(13)	6.5.2005	FV	FV
	Helsinki	Uspenski cathedral’s park II	stones	667:38(13)	27.12.2006	FV	FV
	Helsinki	Krematoriontie (road side)	stones, organic m.	667:38(13)	4.7.2007	FV	FV
	Porvoo	City centre, riverside	fallen wood, bark	669:42(14)	6.1.2007	FV	FV
***Porcellio scaber* Latreille, 1804**							
Field sampling	Åland	Lemland, Herröskatan	shore	667:11(2)	20.5.2007	JT	FV
	Åland	Eckerö, Rödklobbsanden	sandshore	670:11(6)	19.5.2007	JT	FV
	Åland	Eckerö, Skeppsvik	sandshore	669:08(4)	19.5.2007	JT	FV
	Helsinki	Suomenlinna	stones	666:36(12)	6-7.5.2005	FV	FV
	Helsinki	Korkeasaari, Zoo	stones, organic m.	667:38(13)	7.5.2005	FV	FV
	Helsinki	Tähtitorninmäki	big stones	667:38/13)	3.7.2007	FV	FV
	Helsinki	Kaivopuisto park I. “cliff” and “Ursa”	big stones	667:38(13)	4.7.2007	FV	FV
	Helsinki	Kaivopuisto park II	debris, stones	667:38(13)	4.7.2007	FV	FV
	Helsinki	Ullanpuistikko	debris, stones	667:38(13)	3.7.2007	FV	FV
	Helsinki	Katajanokka, school backyard (Merikasarminkatu)	stones, organic m.	667:38(13)	3.7.2007	FV	FV
	Helsinki	Uspenski cathedral’s park I	debris, stones	667:38(13)	6.5.2005	FV	FV
***Porcellio spinicornis* Say, 1818**							
Field sampling	Västanfjärd	Illogrovan, abandoned quarry	under stones, rocks	666:26(8)	26.9.2006	JT	FV
	Åland	Lemland, Herröskatan	shore	667:11(2)	20.5.2007	JT	FV
	Helsinki	Suomenlinna	stones, organic m.	666:36(12)	6-7.5.2005	FV	FV
	Helsinki	Korkeasaari, Zoo	stones, organic m.	667:38(13)	7.5.2005	FV	FV
	Helsinki	Tähtitorninmäki	big stones	667:38(13)	3.7.2007	FV	FV
	Helsinki	Kaivopuisto park I. “cliff” and “Ursa”	big stones	667:38(13)	4.7.2007	FV	FV
	Helsinki	Kaivopuisto park II	stones, organic m.	667:38(13)	4.7.2007	FV	FV
	Helsinki	Ullanpuistikko	stones, organic m.	667:38(13)	3.7.2007	FV	FV
	Helsinki	Katajanokka, school backyard (Merikasarminkatu)	stones, organic m.	667:38(13)	3.7.2007	FV	FV
	Helsinki	”Kaupungin puutarha” park	pleated stone wall	667:38(13)	3.7.2007	FV	FV
	Helsinki	Hesperianpuisto park	big stones	667:38(13)	30.7.2007	FV	FV
	Porvoo	City centre, riverside, trees	fallen wood, bark	669:42(14)	6.1.2007	FV	FV
***Cylisticus convexus* (De Geer, 1778)**							
Field sampling	Västanfjärd	Illogrovan, abandoned quarry	under stones, rocks	666:26(8)	26.9.2006	FV	FV
	Helsinki	Suomenlinna	stones, rocks	666:36(12)	6-7.5.2005	FV	FV
	Helsinki	Korkeasaari, Zoo	stones, rocks	667:38(13)	7.5.2005	FV	FV
	Helsinki	Tähtitorninmäki	stones, rocks	667:38(13)	3.7.2007	FV	FV
	Helsinki	Kaivopuisto park I. “cliff” and “Ursa”	stones, rocks	667:38(13)	4.7.2007	FV	FV
	Helsinki	Korkeasaari, greenhouse	mulch, rotten logs	667:38(13)	7.5.2005	FV	FV
	Helsinki	Ullanpuistikko	plant m., stones	667:38(13)	3.7.2007	FV	FV
	Helsinki	Katajanokka, school backyard (Merikasarminkatu)	debris, bricks	667:38(13)	3.7.2007	FV	FV

Species and source of data	Location	Site	Microhabitat	Coordinate	Date	Leg.	Det.
***Trachelipus rathkii* (Brandt, 1833)**							
Field sampling	Västanfjärd	Illogrovan, abandoned quarry	stones, rocks	666:26(8)	26.9.2006	JT	FV
	Helsinki	Suomenlinna	stones, organic m.	666:36(12)	6–7.5.2005	FV	FV
	Helsinki	Korkeasaari, Zoo	stones, organic m.	667:38(13)	7.5.2005	FV	FV
	Helsinki	Tähtitorninmäki	big stones	667:38(13)	3.7.2007	FV	FV
	Helsinki	Ullanpuistikko	stones, organic m.	667:38(13)	3.7.2007	FV	FV
	Helsinki	Uspenski cathedral's park II	stones	667:38(13)	27.12.2006	FV	FV
	Helsinki	Haagan pappilantie	organic m. under hedge	667:38(13)	2.7.2007	FV	FV
	Porvoo	Kokonniemi, roadside, forest edge	stones, organic m.	669:42(14)	30.6.2007	FV	FV
	Lapua	Vanha Paukku factory yard	debris	699:29(15)	5.8.2008	FV	FV
	Lapua	Lapua river, Lankilankoski farmland	organic m.	699:29(15)	5.8.2008	FV	FV
***Armadillidium nasatum* Budde-Lund 1885**							
Museum material	Espoo	Etuniementie, private flat	under flowerpots garden	667:37(11)	7.11.2002	HM	FV
Field sampling	Helsinki	Korkeasaari, greenhouse		667:38(13)	7.5.2005	FV	FV
***Armadillidium opacum* (C. Koch 1841)**							
Museum material	Åland	Geta, Dånö		671:10(7)	17.9.1975	JOH, BL, IV	FV
	Åland	Finström, Mangelbo		669:11(5)	17.9.1975	JOH, BL, IV	FV
	Åland	Saltvik, Haraldsby		670:11(6)	17.9.1975	JOH, BL, IV	FV
Field sampling	Åland	Lemland, Herröskatan	shore	667:11(2)	20.5.2007	JT	FV
***Armadillidium pictum* Brandt, 1833**							
Museum material	Åland	Sund, Tosarby		669:11(5)	9.7.1967	BL	FV
	Tenala	Modervik, Lildalen		665:28(9)	12.9.1971	Anon	FV
	Åland	Föglö, Björkskär		666:13(1)	8.6.1972 / 22.8.1974	RS	FV
	Åland	Finström, Mangelbo		669:11(5)	17.9.1975	JOH, BL, IV	FV
	Åland	Dånö		671:10(7)	17.9.1975	JOH, BL, IV	FV
	Tammisaari	Jussarö		663:30(10)	11.10.1981	IV	FV
***Armadillidium pulchellum* (Zenker, 1798)**							
Museum material	Åland	Kastelholm		669:11(5)	9.7.1967	BL	FV
Field sampling	Åland	Eckerö, Skeppsvik		669:08(4)	19.5.2007	JT	FV
***Armadillidium vulgare* (Latreille 1804)**							
Field sampling	Helsinki	Suomenlinna		666:36(12)	6-7.5.2005	FV	FV
***Armadillidium zenckeri* Brandt, 1833**							
Museum material	Åland	Jomala, Ytternäs, shore		668:11(3)	22.6.1948	AN	FV

AN: A. Nordman; BL: B. Lönnqvist; EP: E. Palmén; HM: H. Mikkola; IV: I. Valovirta; JOH: J-O. Henriksson; JT: J. Terhivuo; RS: R. Skytén. Serials in parentheses refer to the corrsponding 10 x 10 km grid squares of the sample localities and they correspond to those shown in Fig. 1.

island lying in front of Helsinki city is noteworthy. Palmén (1951) reported a greenhouse *A. vulgare* population with scattered outdoor individuals of it in the Hanko Peninsula in southern Finland where it existed in 1946–50. In central and southern Europe it is among the most common species possessing a world-wide distribution including natural and synanthropic habitats (e.g. Schmalfuss 2003).

According to museum material and our field survey samples *A. pictum* seems to be confined to S and SW Finland including the Åland Islands as already indicated by Palmén (1946a) whereas new *A. opacum* samples refer to Åland. The latter two species are common in temperate Europe, mostly under Atlantic climate (e.g. Berg & Wijnhoven 1998), while *A. nasatum* probably occurs only indoors in Finland. It may be introduced by human agency more or less often with plant material. In addition to loc. 10 in our study its was reported to be present in a greenhouse of the Helsinki University and in a flat in Helsinki (Palmén 1946a, 1947).

Also another common European species viz. *Hyloniscus riparius* (C. Koch 1838) deserves attention due to its outdoor occurrence in Helsinki, Krematoriontie (June 2007, loc. 16, Fig. 1). Prior to our studies this species was found only in greenhouses in Finland in Haaga and Pakila (Palmén 1946a). The occurrence of the species in the centre of Helsinki may indicate a successful colonization and establishment of its population in anthropogenic soil where favourable microclimatic conditions may also prevail.

Considering all the samples from 14 sites in Helsinki (Table 2) eight species were yielded. Some of them namely *P. spinicornis* and *O. asellus* were present in 70% of the sites and some others viz., *P. scaber, T. rathkii* and *C. convexus* were also present in about 40% of the sample sites. The latter species was also present in loc. 1. Palmén (1946a) listed several localities with anthropogenic soil close to human settlements for it on southern coast of Finland including the Åland Islands.

The field samplings in the urban environments of Porvoo yielded four species, and those in Åland resulted data on six species. Of the material inspected the most frequent species was *P. scaber*. It has been introduced to many parts of the world (e.g. Oliver & Meechan 1993; Schmalfuss 2003) and it plays a dominating role in North European isopod assemblages (e.g. in Denmark: Vilisics *et al.* 2007).

We found *O. asellus* only on southern coast of Finland but it may be present also on the Åland Islands (Palmén 1946a).

4. Discussion

Our report is a contribution to the knowledge of terrestrial isopod occurrences in Finland and it refers to 14 species altogether. Although our data derive from different origins (e.g. collectors, sampling methods) on a wide timespan, we can suggest that most outdoor populations of terrestrial isopods in Finland represent common, Holarctic and cosmopolitan species (e.g. *O. asellus, P. scaber, P. spinicornis, T. rathkii*).

Our results delineate an interesting duality in the Isopoda fauna of Finland. Typically, isopods were found in urban environments, while only traces from the total sample originated from natural or rural areas.

Isopoda populations are established mostly in urbanized southern coastal parts of Finland, but separate viable populations were found as far as Lapua in South Ostrobothnia (Etelä-Pohjanmaa). The outdoor Oniscidea fauna of Helsinki is confined to species that play important role in biotic uniformization in European cities (e.g. Vilisics & Hornung 2009; Szlávecz *et al.* unpublished). This indicates that only the most tolerant habitat generalist isopods can successfully establish themselves in Finland, given a combination of possible limiting factors, i.e. lack of calcareous bedrock, long and cold winters, spruce and pine forests providing low quality food. Urban areas such as Helsinki, however, can be regarded as „pseudo tropical bubbles" (Schochat *et al.* 2005) providing better conditions for species establishment by tempered microclimate (Andreev 2004), habitat heterogeneity and a high vascular plant diversity compared to the original species pool (Vähä-Piikkiö *et al.* 2004). The increased proportion of immigrants and cultivation escapees in the vegetation of Helsinki (Vähä-Piikkiö *et al.* 2004) is suitable for Isopoda establishment due the possible higher variety of food source for woodlice.

As a probable result of the factors mentioned above, isopod populations seem to occur sporadi-

cally and they seem to become less frequent northwards as indicated by the high proportion of our field sampling sites with no isopods found. Such zero-count sites represented about half of our field samplings taken from both urban areas as well as habitats with minor impact of human.

These results provide additional knowledge on how isopods establish in unsuitable regions such as north Europe by colonizing urban areas first. Greenhouses and private gardens can be considered as introduction hot-spots in cities (Vilisics & Hornung 2009) and a potential springboard to colonize other areas at the same time.

In the light of these facts, accelerating human activity, (i.e. habitat alteration, heat island effect) in the future may play an important role in the introduction, establishment and spread of terrestrial isopods in Finland.

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