

Parastenocarididae (Copepoda, Harpacticoida) from The Netherlands

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Abstract

A survey of the groundwater fauna of The Netherlands has revealed the presence of 4 species of Parastenocarididae, viz. *Parastenocaris fontinalis* Schnitter & Chappuis, 1915, *P. tumida* Kiefer, 1961, *P. germanica* Kiefer, 1936, and *P. nollii* Kiefer, 1938, the latter two being new for The Netherlands. *P. tumida* is only imperfectly known, but there is enough material so that a full description can now be given not only of the female but also of the male hitherto unknown.

Résumé

Une étude de la faune aquatique souterraine des Pays-Bas a mis en évidence la présence de 4 espèces de Parastenocarididae, à savoir *Parastenocaris fontinalis* Schnitter & Chappuis, 1915, *P. tumida* Kiefer, 1961, *P. germanica* Kiefer, 1936 et *P. nollii* Kiefer, 1938; ces deux dernières espèces sont nouvelles pour le pays. *P. tumida* est une espèce imparfaitement connue; grâce au matériel suffisant collecté, une description complète peut maintenant en être donnée, non seulement de la femelle, mais aussi du mâle jusqu'à présent inconnu.

Introduction

Several samples taken by Dr. J.H. Stock mostly in 1953 along the shore of the IJsselmeer at Muiderberg have yielded the only records of Parastenocarididae in The Netherlands so far. Kiefer (1961) who studied these samples found three species: *Parastenocaris fontinalis borea* Kiefer, 1960, *Parastenocaris phyllura* Kiefer, 1938, and a new species which he called *Parastenocaris tumida*. He had only a single damaged female of this species at

his disposal so that he could do no more than give a description of its last abdominal somite and furcal rami as well as of its P5. *P. tumida* is recognizable by the swollen base of its main terminal seta on the female furcal rami.

From February to July 1989 the second author, with assistance of K. de Boom, made an extensive survey of the groundwater fauna of The Netherlands and discovered four species of Parastenocarididae in his samples. Two of these species are new to The Netherlands. One of the remaining two species is *P. tumida* of which enough specimens of both sexes are now available to give a full description.

Material and methods

The wells investigated were bore holes of about 20–30 cm diameter. They give access to the phreatic groundwater; the water table was 2 to 5 m below the surface. These wells have a coarse screen and can give in general a minimal amount of 90 m³/h water. The samples were taken by pumping 1200 l of water (1 l/s) with a centrifugal pump and filtering through a plankton net of 41 µm. Subsamples were taken after 2, 5, 10 and 20 minutes. After sampling of the fauna, water samples for physicochemical analyses were taken and oxygen and temperature were measured about 3 m below the water table with a WTW OXI 196. The samples were sorted before fixation, under a dissection microscope, and the animals were preserved in 70% ethanol. Chemical and physical analyses have been performed by the RIVM laboratory of inorganic chemistry (LAC) (see Table I). Specimens have been dissected for examination or mounted whole in a droplet of W15 (Zeiss). Drawings have been made using a Leitz Dialux phase contrast microscope and a camera lucida. The material is

Table I. Chemical and physical data

Station number	801	805	806	810	811	812	813	815	820	821	822	825	826	830
Chloride (mg/l)	15.5	43.1	56.9	56.8	48	22.9	12.7	26	14.7	35.1	83.7	34.8	46.5	38.9
Sulphate (mg/l)	20.6	66.6	45.4	71.3	70.8	30.9	30.4	34.6	34.9	13.4	70.2	74.9	117.2	19.7
Phosphate ($\mu\text{g/l}$)	18	74	74	21	21	29	43	263	526	67	335	23	113	24
Hydrogen carbonate (mg/l)	6	115	77	400	180	131	116	60	40	342	284	11	46	46
Nitrate (mg/l)	11	13	22	8	170	64	3	1	16	1	1	74	1	1
Ammonium (mg/l)	0.02	0.02	0.02	0.08	0.11	0.04	0.45	0.17	0.58	0.61	0.31	0.02	0.22	0.06
Potassium (mg/l)	2	2	1.7	2.1	5.1	1.3	3.2	2.6	4.7	1.7	1.5	15.2	6.1	1.8
Calcium (mg/l)	7.9	65.2	46.7	131.1	120.1	64.6	46.6	26.4	62.3	104.6	122.8	42.9	26.5	24.8
Magnesium (mg/l)	3.4	10.2	12.2	13.3	13.3	8.4	2.9	3.5	10.7	12.1	10.6	7	14.8	1.4
Sodium (mg/l)	9.3	17	19.7	53.6	35.1	13.4	10.4	15.6	25.1	17.7	47.5	18	23.8	20.9
Iron ($\mu\text{g/l}$)	6	10	6	469	201	6	676	7345	64	2011	4396	33	17435	58
DOC (mg/l)	0.6	1.8	0.9	2.7	1.3	0.5	3.3	2.5	1.2	2.4	0.2	0.8	4.9	1.6
Total Phosphor (mg/l)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.09	0.36	0.06	0.14	0.06	0.06	0.06
EC (25°C) ($\mu\text{S/cm}$)	124	444	410	827	798	421	274	233	206	578	747	411	426	232
pH	5.65	7.59	6.9	7.36	7.85	7.8	7.51	6.42	6.37	7.69	7.17	5.93	5.9	7.44
Oxygen (mg/l)	3.5	2.3	3.7	0.3	2.9	3.3	0.2	0.3	2.6	0.7	0.1	0.2	0.3	8
Temperature (°C)	9.9	9.6	10.6	11.1	10.7	9.7	10.0	11.2	10.4	10.5	10.5	10.9	11.2	10.5

deposited at the Zoological Museum of the University of Amsterdam.

Terminology for descriptions as in Hamond (1987) and for furcal setae as in Huys (1988).

Localities with *Parastenocaris* (see Fig. 1)

- Sta. 801. Well situated near golf-court "De Pan", E. of De Bilt, prov. Utrecht, coordinates (Amersfoort grid): 143.65, 458.70, altitude 5 m + N.A.P. (9 February 1989).
Co-occurring fauna: Rotatoria, Tardigrada, Nematoda, Acari.
P. germanica 1 σ .
- Sta. 805. Well 1 at Bartimeushagen, W. of Doorn, prov. Utrecht, coordinates: 150.80, 450.35, altitude 6.2 m + N.A.P. (8 March 1989).
Co-occurring fauna: Rotatoria, Nematoda, Acari, *Paracyclops fimbriatus*.
P. germanica 2 $\sigma\sigma$, 17 ff , 4 copepodids.
- Sta. 806. Well 2 at Bartimeushagen, W. of Doorn, prov. Utrecht, coordinates: 150.70, 450.40, altitude 6.2 m + N.A.P. (8 March 1989).
Co-occurring fauna: Rotatoria, Tardigrada, Nematoda, Acari.
P. spec., 1 copepodid.
- Sta. 810. Well just S. of the main road in the centre of Beuningen, prov. Gelderland, coordinates: 181.8, 430.6, altitude 8.5 m + N.A.P. (29 March 1989).
Co-occurring fauna: Rotatoria, Tardigrada, Enchytraeidae, Nematoda, Acari, Cyclopiniae.
P. fontinalis 1 f , 1 copepodid.
- Sta. 811. Well just S.E. of the church at Kilder, community of

Bergh (Montferland), prov. Gelderland, coordinates: 123.15, 439.01, altitude 15 m + N.A.P. (4 April 1989).

Co-occurring fauna: Rotatoria, Nematoda (e.g. *Onchulus nollii* Goffart, 1950), *Antrobathynella stammeri* (Jakobi, 1954).

P. germanica 8 $\sigma\sigma$, 19 ff , 11 cop.; *P. nollii* 2 $\sigma\sigma$; *P. tumida* 10 $\sigma\sigma$, 26 ff , 4 cop.

- Sta. 812. Well just E. of the road from Beek to Kilder, about 500 m north of Beek, community of Bergh (Montferland), prov. Gelderland, coordinates: 210.57, 436.60, altitude 18 m + N.A.P. (4 April 1989).
Co-occurring fauna: Rotatoria, Tardigrada, Enchytraeidae, Nematoda (e.g. *Onchulus nollii*), Acari.
P. germanica 5 $\sigma\sigma$, 4 ff ; *P. nollii* 2 $\sigma\sigma$, *P. tumida* 10 $\sigma\sigma$.
- Sta. 813. Well N. of Dinxperloo, along the road to De Heurne, prov. Gelderland, coordinates: 230.48, 432.70, altitude 18 m + N.A.P. (25 April 1989).
Co-occurring fauna: Rotatoria, Tardigrada, Nematoda, Acari.
P. fontinalis 1 f .
- Sta. 815. Well just along a road in the S.E. part of Heerde, prov. Gelderland, coordinates: 199.60, 488.8, altitude 7 m + N.A.P. (9 May 1989).
Co-occurring fauna: Rotatoria, Nematoda (e.g. *Onchulus nollii*), Acari.
P. germanica 1 f .
- Sta. 820. Well along road just S.W. of St. Agatha, S. of Cuyck, prov. Noord-Brabant, coordinates: 191.04, 413.95, altitude 11 m + N.A.P. (14 June 1989).
Co-occurring fauna: Rotatoria, Tardigrada, Enchytraeidae, Nematoda, Acari, *Diacyclops lan-*

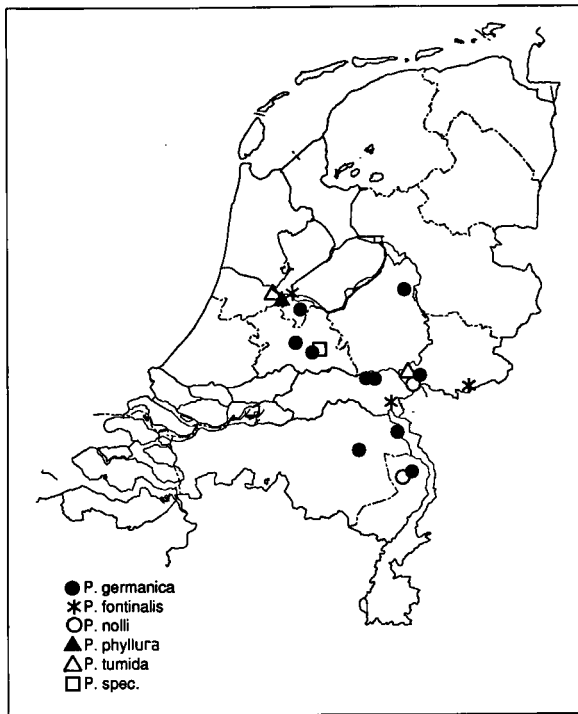


Fig. 1. New records of *Parastenocaris* from The Netherlands (including the old record from Muiderberg).

guidoides-group, *Antrobathynella stammeri*.

P. germanica 50 ♂♂, 72 ♀♀, 11 cop., 2 nauplii.

Sta. 821. Well E. of Randwijk, community of Heteren, prov. Gelderland, coordinates: 178.16, 440.51, altitude 7 m + N.A.P. (14 April 1989).

Co-occurring fauna: Rotatoria, Tardigrada, Nematoda, Acari, *Diacyclops languidoides* (Lilljeborg, 1901).

P. germanica 20 ♂♂, 21 ♀♀, 1 cop.

Sta. 822. Well just W. of Heteren, prov. Gelderland, coordinates: 179.77, 441.41, altitude 9.5 m + N.A.P. (14 April 1989).

Co-occurring fauna: Rotatoria, Tardigrada, Nematoda.

P. germanica 12 ♂♂, 7 ♀♀.

Sta. 825. Well in the centre of Swolgen, community Meerlo-Wanssum, prov. Limburg, coordinates: 205.70, 389.48, altitude 19 m + N.A.P. (27 June 1989).

Co-occurring fauna: Rotatoria, Nematoda, Acari.

P. germanica 2 ♂♂, 4 ♀♀; *P. nollii* 1 ♂, 5 ♀♀.

Sta. 826. Well at Hengstheuvel, N. of Uden, prov. Noord-Brabant, coordinates: 170.58, 410.12, altitude 17 m + N.A.P. (27 June 1989).

Co-occurring fauna: Rotatoria, Nematoda, Acari.

P. germanica 1 ♂, 2 ♀♀, 1 cop.

Sta. 830. Well N. of Hilversum, prov. Noord-Holland, coordinates:

141.5, 473, altitude 5 m + N.A.P. (13 July 1989).

Co-occurring fauna: Rotatoria, Enchytraeidae, Nematoda (e.g. *Onchulus nollii*), Acari.

P. germanica 3 ♂♂, 1 ♀, 5 cop.

Description of *Parastenocaris tumida* Kiefer, 1961

Material. – One dissected male, one dissected female, four whole males, and four whole females (sta. 811)

Male. – Length 344 μ m, nine times longer than greatest width. Rostrum with 2 lateral sensillae. Prosome and abdominal segments 1–4 with dorsal nuchal organ. Anal operculum with median concavity. Furcal rami (Fig. 3c) 2.75 times longer than greatest width, all 3 anterolateral setae conspicuous and located in distal third of ramus, posterolateral seta one-sided spinulose distally, all other setae bare.

A1 7-segmented, number of setae beginning with proximal segment: 0/6/4/5 + aesthetask /1/1/9 + aesthetask, aesthetask of fourth segment small, not reaching beyond tip of antennule. A2 as usual for family. Mouthparts as described for *P. inferna* in Schminke (1971).

P1 (Fig. 2a) on inner side of basis with hook having caudally pointing tip, with fine seta adjacent to hook. P2 (Fig. 2b) with 3-segmented exp., its segments 1 and 3 with inner frill, its segment 2 instead with row of spinules; basis with pore proximally. P3 (Fig. 2c) with both segments of exp. fused, portion of proximal segment ending with s-shaped outer spine (“thumb”), its inner rim proximally with darkly sclerotized spike and distally with rounded membrane-like protrusion, portion of distal segment (“apophysis”) short and confluent with apical spine, basis with pore proximally. P4 (Fig. 2e) with spine-like, inwardly curved enp. spinulated distally along inside, next to it on inner side of basis 2 spinules, one very small, innermost as big as enp. and curved to outside; exp. 3-segmented, its segments 1 and 3 with inner frill, its segment 2 instead with row of spinules, P5 (Fig. 3a) small, triangular with inner thorn and with 4 setae.

Female. – Length 332 μ m. Identical with male

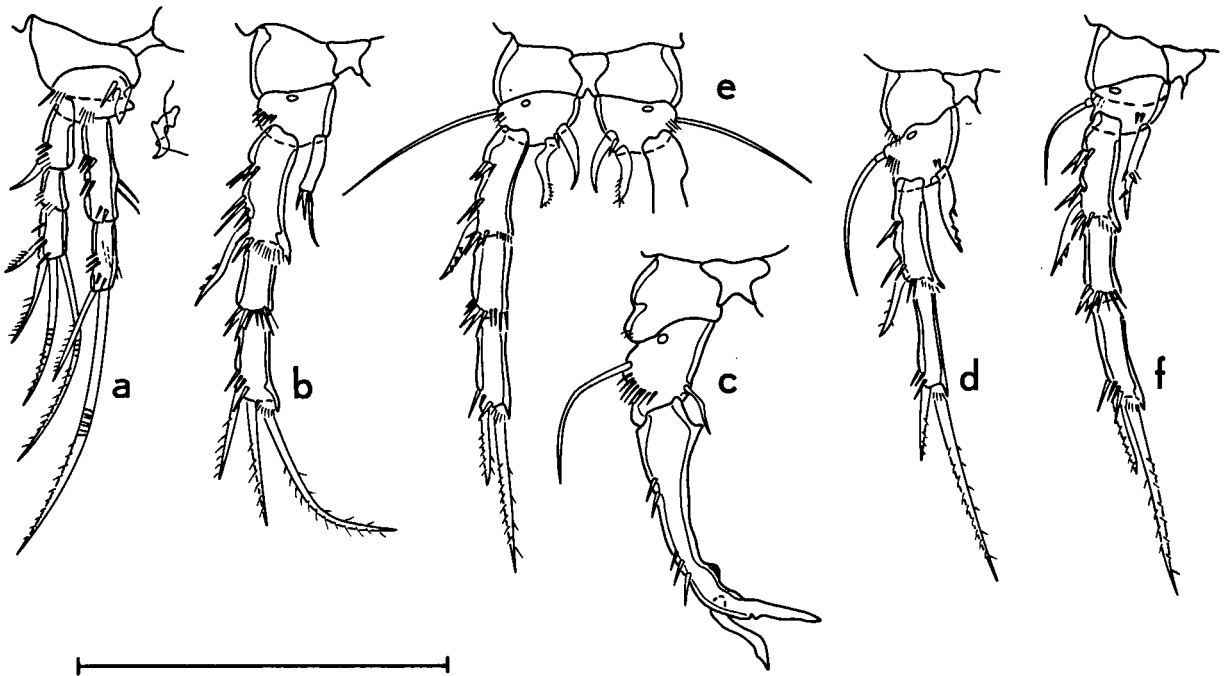


Fig. 2. *Parastenocaris tumida* Kiefer, 1961: a, Pereopod 1 (= P1) ♂, inset: hook of basis (lateral view); b, P2 ♂; c, P3 ♂; d, P3 ♀; e, P4 ♂; f, P4 ♀. Scale bar: 0.05 mm.

except for antennule, P1, P3, P4, genital field, and furcal ramus. Prosome, genital double-somite and abdominal segments 3 + 4 with nuchal organ. Inner terminal seta of furcal ramus (Fig. 3d) with swollen base.

A1 7-segmented, not prehensile, number of setae beginning with proximal segment: 0/4/4/2 + aesthetask /1/1/9 + aesthetask.

P1 without hook, but with seta at inner side of basis. P3 (Fig. 2d) with 2-segmented exp., both segments with inner frill; enp. short, confluent with terminal seta which carries few spinules along inner rim; basis with 2 microspinules above enp. P4 (Fig. 2f) with slender enp. confluent with terminal seta; 3 spinules indicate the end of enp.; basis with two microspinules above enp. Genital field as in Fig. 3b, dotted lines indicating inner structure (antrum and receptaculum).

Affinities. – The lack of detail in previous descriptions of Parastenocarididae makes it difficult to discuss the relationship of *P. tumida* with other species of the family. The greatest similarities seem to

be with four species from Yugoslavia, viz. *Parastenocaris karamani* Chappuis, 1937, *P. balcanica* Petkovski, 1959; *P. narentina* Petkovski, 1959, and *P. rascana* Petkovski, 1959. All these species agree with *P. tumida* in having the proximal spike on the inner rim of the P3 exp. male, more or less the same length relationship between “apophysis” and “thumb” of P3 male, and as far as indicated two groups of spinules along the outer edge of P3 exp. male. P4 enp. male is curved inwardly in all those species and accompanied by 2 (-3) outwardly pointing spinules adjacent to it on the inner side of the basis. P5 is triangular with an inner thorn in all cases. The 3 anterolateral setae are like in *P. tumida* located in the distal third of the furcal rami. It is not known whether the species from Yugoslavia also have a hook on the inside of the basis of P1 male because there are no figures of this appendage. The female is only known for *P. narentina* so that only males can be compared.

Distribution. – Apart from the type locality on the shore of the IJsselmeer at Muiderberg (see Fig. 1)

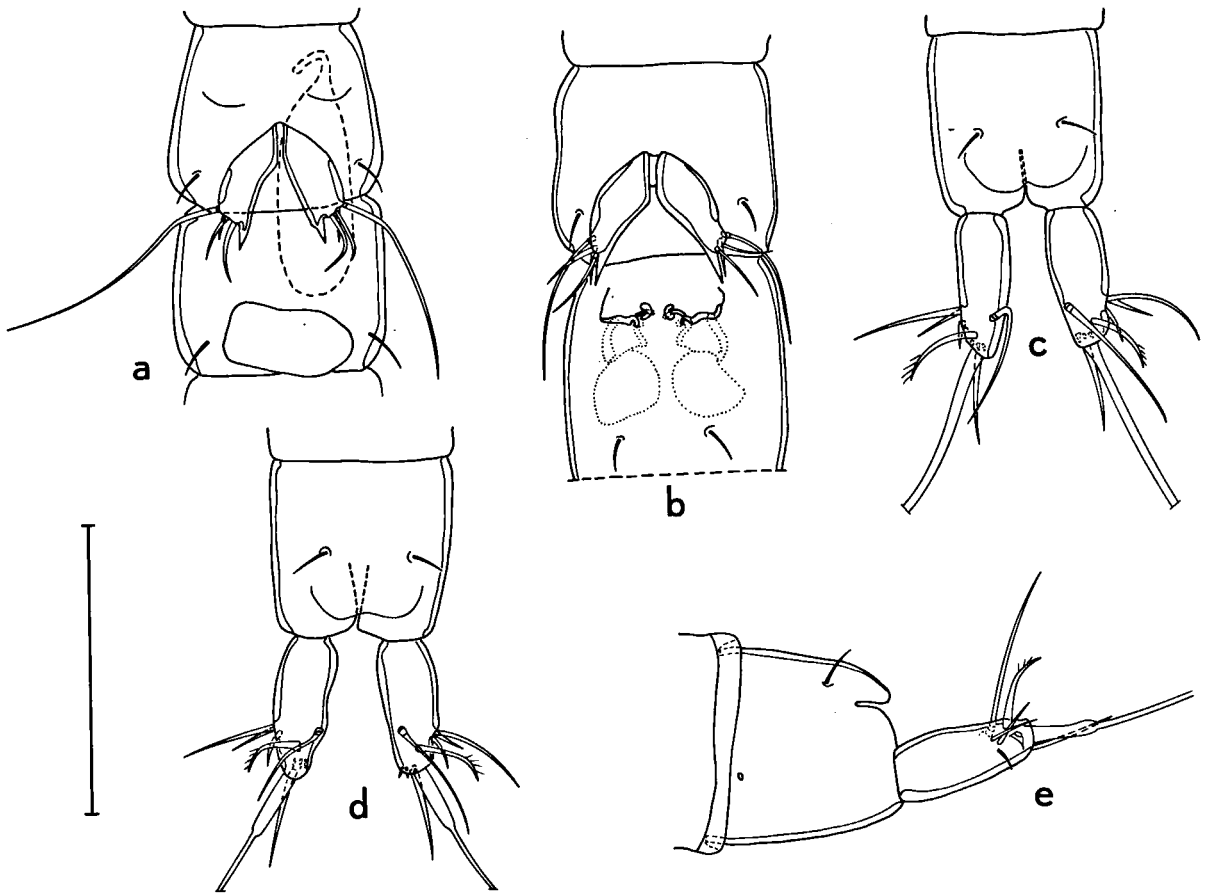


Fig. 3. *Parastenocaris tumida* Kiefer, 1961: a, Pereopod 5 (= P5) ♂; b, P5 ♀ and genital field; c, anal segment and furcal rami ♂ (dorsal view); d, the same of ♀; e, anal segment and furcal ramus ♀ (lateral view). Scale bar: 0.05 mm.

Parastenocaris tumida has been recorded from two localities in southern Sweden. But Enckell (1969) put a question mark in front of the species name. It is also doubtful whether the only female with a swollen base of the inner terminal seta of the furcal rami that occurred among a great number of females of *P. glacialis* Noodt, 1952 on the shore of the Selenter See near Kiel (Germany) can be attributed to *P. tumida*. Noodt (1952) regarded this seta as a malformation, but Kiefer (1961) argued that this particular female was not an aberrant form of *P. glacialis* but a representative of his *P. tumida*.

Remarks on the remaining species

Kiefer (1961) reported *Parastenocaris fontinalis borea* Kiefer, 1960 from the shore of the IJssel-

meer. It cannot be said to which subspecies the two specimens in our material belong, as there are no males. The distinguishing feature is a strong spine on the inner rim of the male P5. *P. fontinalis* is widely distributed in Europe having been recorded from Switzerland, France, Austria, Czechoslovakia, Germany, The Netherlands, Denmark, and Sweden (Rouch, 1986).

Parastenocaris germanica Kiefer, 1936 has the widest distribution in The Netherlands as revealed by the present study (see Fig. 1). Its male may be mistaken for that of *P. phyllura* Kiefer, 1938 both having very conspicuous leaf-like furcal rami when viewed from the side. To distinguish between the two a closer inspection of the P5 is necessary. In the male of *P. germanica* the innermost seta reaches far beyond the tip of the P5, is strong and claw-like and

curved to the inside. In *P. phyllura* this seta is not transformed as can in both cases be seen in undissected specimens. *P. germanica* is otherwise known only from near Karlsruhe and near Aschaffenburg in Germany. There is one record from Budapest (Török, 1951).

Parastenocaris nolli Kiefer, 1938 is easily recognized by its long slender furcal rami. It has a wide distribution in Germany along the rivers Rhine, Weser, Elbe, and their tributaries. There is one record from near Lunz in Austria (Brehm, 1955).

Co-occurring fauna

The Acari found together with *Parastenocaris* were all typical soil-inhabiting mites and no Limnopalacariidae. It is unclear if this fauna has to be considered as accidentals of the wells or that it is amphibian and can live in the uppermost saturated layers as well. The fact that living mites have been found in the last subsamples may indicate that at least a fraction of the mites can live in the saturated layer.

The Nematoda fauna consists of a mixture of typical soil inhabitants, plant parasites, and freshwater forms. It is interesting to note the occurrence of *Onchulus nolli* (stations 811, 812, 815, and 830), frequently recorded from German groundwater habitats.

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References

- Brehm, V., 1955. Süßwasserfauna and Tiergeographie. Österr. Zool. Z., 6: 250–269.
- Enckell, P.H., 1969. Distribution and dispersal of Parastenocarididae (Copepoda) in northern Europe. Oikos, 20: 493–507.
- Hamond, R., 1987. Non-marine harpacticoid copepods of Australia. I. Canthocamptidae of the genus Canthocamptus Westwood s. lat. and Fibulacamptus, gen. nov., and including the description of a related new species of Canthocamptus from New Caledonia. Invertebr. Taxon., 1 (8): 1023–1247.
- Huys, R., 1988. A redescription of the presumed associated Caligopsyllus primus Kunz, 1975 (Harpacticoida, Paramesochridae) with emphasis on its phylogenetic affinity with Apodopsyllus Kunz, 1962. Hydrobiologia, 162: 3–19.
- Kiefer, F., 1961. Über einige Parastenocariden (Copepoda, Harpacticoida) aus den Niederlanden. Crustaceana, 3 (2): 116–119.
- Noodt, W., 1952. Subterrane Copepoden aus Norddeutschland. Zool. Anz., 148 (11/12): 331–343.
- Rouch, R., 1986. Copepoda: Les Harpacticoides souterrains des eaux douces continentales. In: L. Botosaneanu (ed.), Stygofauna mundi: 321–355 (E.J. Brill/Dr. W. Backhuys, Leiden).
- Schminke, H.K., 1971. Zwei neue Parastenocaris-Arten (Copepoda, Harpacticoida) von Tenerife (Kanarische Inseln). Gewäss. Abwäss., 50/51: 66–75.
- Török, P., 1951. Quelques nouvelles écrevisses caractéristiques pour l'eau souterraine concernant la faune de la Hongrie. Acta biol. Acad. Sci. Hung., 2: 281–285.

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