Estonian Journal of Ecology, 2010, **59**, 4, 281–295 doi: 10.3176/eco.2010.4.03

On the Estonian fauna of Harpacticoida (Crustacea, Copepoda)

Elena Fefilova

Institute of Biology, Komi Scientific Centre, Ural Branch of the Russian Academy of Sciences, 28 Kommunisticheskaya St., 167982 Syktyvkar, Russia; fefilova@ib.komisc.ru

Received 30 March 2010, revised 16 August 2010

Abstract. For the first time a faunistic and ecological review of 18 harpacticoid species and forms from Estonia is presented. They were sampled in May and September and inhabit different types of freshwater habitats: from micro-waterbodies among hygrophilous plants to large lakes of Peipsi and Võrtsjärv. The harpacticoid species occurring in Estonia belong to thermophilic, cold-preferring, and eurythermic ecological groups. A new harpacticoid subspecies *Maraenobiotus brucei estonicus* E. Fefilova subsp. nov. from wet plants under a waterfall is described. It differs from the known subspecies of *M. brucei* in the structures of the exopodite of antenna, mandibular palp, endopodite of leg 2, and spines on abdominal somites.

Key words: freshwater Harpacticoida, new subspecies, ecology, distribution.

INTRODUCTION

No special research on harpacticoids (Harpacticoida, Copepoda) has been made so far in Estonia. Still, unidentified harpacticoids were stated in the meiobenthos of Estonian waterbodies of different types (Timm, 2002). One species was known in Lake Võrtsjärv (Timm, 1973) and five species, one of them identified only up to genus, were recorded from Lake Peipsi (Haberman, 2001). Meanwhile, in other European regions, including the Leningrad Region of Russia bordering on Estonia, richer harpacticoid faunas have been described (Kurashov, 1994; Sarkka, 1995). Owing to their high ecological diversity these crustaceans inhabit main benthic biotopes in salt and fresh waterbodies of all types. They can be found in habitats not easily accessible for other hydrobionts, like wet sand on beaches and between terrestrial plants. According to Veldre & Mäemets (1956), the fresh and brackish water ecosystems of Estonia may include about 40 harpacticoid species. This assumption is based on the analysis of the faunas of West European regions with similar climatic conditions. It is known that the harpacticoids are indicators of different environmental conditions and water quality (Kurashov, 1994; Sarkka, 1995; Andronnikova, 1996).

The aim of the investigation was to discover harpacticoid fauna and its particularities in different types of freshwater bodies of Estonia.

MATERIAL AND METHODS

Harpacticoids were collected in the eastern part of Estonia (Fig. 1) on 25–28 September 2007 and on 5–12 May 2008. Some data about sampling sites are presented in Table 1. In shallow water the samples were obtained by a hand-net. From deeper zones of lakes Võrtsjärv and Peipsi sediment samples were taken with a bottom grab. A total of 52 samples containing harpacticoids were collected. The samples were filtered through a 100 μm mesh size net and fixed with 4% formaline. In May and September there are biological spring and autumn in Lake Võrtsjärv and the mean daily water temperature is 4–15 °C in these periods (Järvet, 2004).

For the determination of the similarity of harpacticoid faunas Sørensen's coefficient (Sørensen, 1948) was used.

RESULTS AND DISCUSSION

Eighteen harpacticoid species and forms belonging to three families were found in the samples studied. Brief information about their distribution, ecology, and biology is presented below.

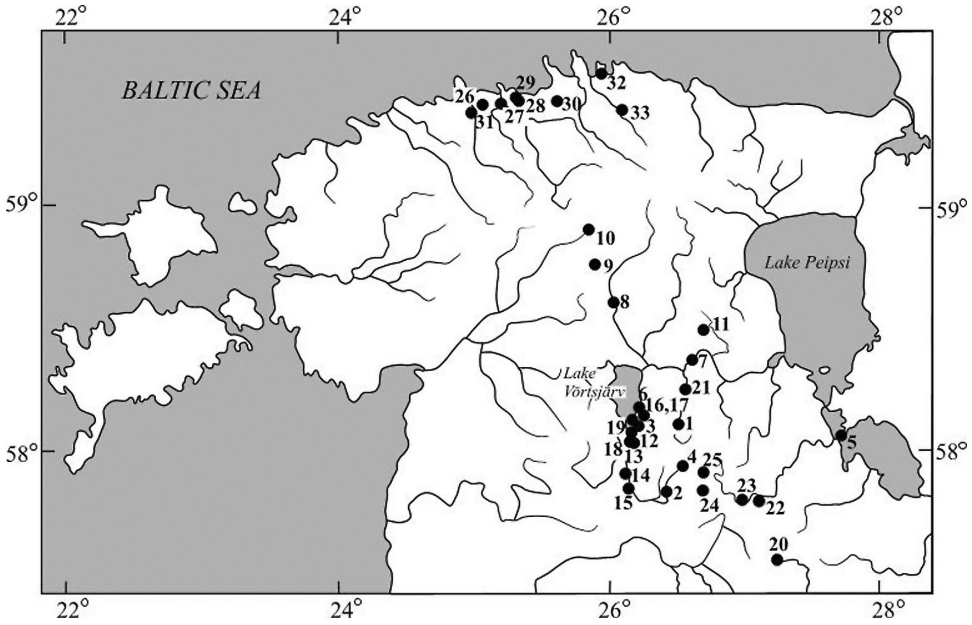

Fig. 1. Map of Estonia with sampling points. Numbers of the sampling points correspond to those in Table 1.

Table 1. Some characteristics of the sampling places. pl – aquatic plants, br – boulders, d – detrital matter, m – moss, pb – pebbles, pt – peat, sd – sand, st – silt. In brackets – sampling site

No. (on the map)	Waterbody	Date	Substrate
1	Elva River (Palu)	25.09.2007	pl, br, pb, st
2	Väike Emajõgi River (Restu)	25.09.2007	d, pb, pl
3	Nuudaläte Spring	25.09.2007	pb, m, pt
4	Lake Pühajärv	25.09.2007	pl, br, pb, sd, st
5	Lake Peipsi (Lämmijärv, at Salosaar Island)	25.09.2007	d, st
6	Lake Võrtsjärv (Limnological Station)	25.09.2007, 15.05.2008	sd, st
7	Suur Emajõgi River (Kärevere, blind arm)	26.09.2007	pl
8	Põltsamaa River (Põltsamaa)	26.09.2007	br, pb
9	Esna River (Põhjaka)	26.09.2007	br, pb, sd, st
10	Roosna-Alliku Spring	26.09.2007	br, pb
11	Lake Saadjärv	26.09.2007	br, pb
12	Rõngu River (mouth)	27.09.2007	d, sd, st
13	Väike Emajõgi River (Pikasilla)	27.09.2007	pl, sd
14	Väike Emajõgi River (Jõgeveste)	27.09.2007	br, pl, sd
15	Väike Emajõgi River (Hummuli)	27.09.2007	d, sd, st
16	Mire at Lake Valguta Valgjärv	27.09.2007, 25.09.2007	pl, pt
17	Ditch at Lake Valguta Mustjärv	25.09.2007	pl, pt
18	Lake Võrtsjärv (Vooremägi)	25.09.2007	sd
19	Lake Võrtsjärv (Haani)	25.09.2007	br, sd
20	Lake Hino	05.05.2008	d, sd
21	Lake Karijärv	05.05.2008	d, sd, pt
22	Lake Tamula	07.05.2008	d, sd, pt
23	Lake Vagula	07.05.2008	sd
24	Lake Lõõdla	07.05.2008	d, sd
25	Lake Kooraste Suurjärv	07.05.2008	sd
26	Pirita River (Lagedi)	12.05.2008	d, st
27	Jägala River (Jägala)	12.05.2008	d, m, sd, st
28	Kaberla River	12.05.2008	sd, st
29	Valkla River	12.05.2008	pb, sd
30	Loo River	12.05.2008	sd, st
31	Lake Maardu	12.05.2008	br, sd
32	Lake Käsmu	12.05.2008	d, sd
33	Lake Viitna Pikkjärv	12.05.2008	sd

Family Ameiridae

Nitocrella hibernica (Brady, 1880)

Location, ecology, and biology. Rivers: Elva, Väike Emajõgi. Lakes: Saadjärv, Peipsi, Võrtsjärv, Lõõdla, Vagula, Käsmu, Pühajärv. Blind arm of the Suur Emajõgi River. Both females and males occurred in May and September on different substrata. Also females with egg sacks were detected in both months. Copepodites were found in May only.

General distribution and biology. Widespread in medium and southern latitudes in the Palaearctic Region, mainly in large freshwater lakes and rivers (Borutskij, 1952).

Family Canthocamptidae

Canthocamptus staphylinus staphylinus (Jurine, 1820)

Location, ecology, and biology. Rivers: Jägala, Loo, Pirita, Väike Emajõgi, Esna, Rõngu. Lakes: Saadjärv, Pühajärv, Peipsi, Võrtsjärv, Lõõdla, Hino, Kooraste Suurjärv, Vagula, Käsmu, Maardu. Blind arm of the Suur Emajõgi River. Females and males were present. Copulating individuals and egg-bearing females were found at the end of September, 5th instar copepodites in May.

General distribution, ecology, and biology. Widespread in the Palaearctic Region, including North Africa. It inhabits both small (even temporary pools) and large waterbodies. According to various data (Sarvala, 1979; Kurashov, 1994; Fefilova, 2007), the species is considered cold-stenothermic, mono- or dicyclic, capable of parthenogenetic reproduction. Different authors argue that it prefers either oligo- (Sarvala, 1979) or P-mesosaprobic conditions (Borutskij, 1952).

Paracamptus schmeili (Mrazek, 1894)

Location, ecology, and biology. Only females of this species were found in spring and autumn in the Põltsamaa River and lakes Peipsi and Võrtsjärv. Egg-bearing females and copepodites occurred in September.

General distribution, ecology, and biology. Palaearctic, living in rivers and lakes. Polycyclic (Sarvala, 1990; Fefilova, 2007) and oligosaprobic (Sarkka, 1995).

Bryocamptus (Bryocamptus) minutus (Claus, 1863)

Location, ecology, and biology. Springs: Nuudaläte, Roosna-Alliku. Rivers: Põltsamaa, Rõngu, Väike Emajõgi, Esna. Lakes: Saadjärv, Pühajärv, Võrtsjärv, Maardu. Earlier the species was stated for Lake Peipsi (Haberman, 2001). In spring and autumn, both females and males were detected. Copulating individuals and copepodites were observed at the end of September, females with egg sacks in May and September.

General distribution and biology. Holarctic (Rundle et al., 2000), inhabiting both large and small waterbodies (Borutskij, 1952).

Phenotypic variability. Individuals of *B. minutus* in the littoral zone of Lake Võrtsjärv (Haani) had essential distinctions in their definitive lengths (Fig. 2). The adult individuals of both sexes were 0.40–0.65 mm long, the average length of females was 0.53 ± 0.02 and of males 0.48 ± 0.02 mm. Such difference in size of adult copepods from one population can be the result of co-existence of more than one generation, grown up at different temperature conditions (Afanas′eva, 1977).

Fig. 2. Adult females of *Bryocamptus (B.) minutus* from the littoral zone of Lake Võrtsjärv. Scale 0.5 mm.

Bryocamptus (Bryocamptus) vejdovskyi (Mrazek, 1893)

Location. A single female was found on silt in the spring pond of Esna in September.

General distribution and biology. Like *B. minutus*, it is distributed in the Nearctic and Palaearctic regions (Rundle et al., 2000), both in large and small waterbodies, including temporary snow-melt pools (Borutskij, 1952; Damian-Georgescu, 1970). In middle latitudes the species is dicyclic (Borutskij, 1952).

Bryocamptus (Rheocamptus) pygmaeus (G. O. Sars, 1863)

Location, ecology, and biology. Springs: Nuudaläte and Roosna-Alliku. Lake Viitna Pikkjärv. A mire at Lake Valguta Valgjärv. On wet terrestrial plants under the waterfall on the Jägala River at Jägala-Joa. In May and September. Females and males were detected. Egg-bearing females and 4th–5th instar copepodites occurred in spring samples.

General distribution and biology. In Europe, North America, and North Africa. In Europe widespread, except the tundra zone. It inhabits waterbodies of different types; frequent in eutrophic and transitory bogs and in ground-water. In middle latitudes the species is polycyclic (Borutskij, 1952).

Bryocamptus (Rheocamptus) zschokkei (Schmeil, 1893)

Location, ecology, and biology. Springs: Nuudaläte and Roosna-Alliku. Rivers: Elva and Valkla. In September; both females and males were found, including egg-bearing females.

General distribution and biology. Distinct subspecies are widespread in the Holarctic Region (Borutskij, 1952; Rundle et al., 2000). In middle latitudes only in mountain waters and cool springs, cold-stenothermic (Borutskij, 1952).

Echinocamptus echinatus (Mrazek, 1894)

Location, ecology, and biology. Roosna-Alliku Spring. Rivers: Kaberla and Valkla. Females and males were found, including females with egg sacks, in May and September.

General distribution and biology. In Europe in middle latitudes, inhabiting mountain waterbodies and springs; cold-preferring (Borutskij, 1952).

Maraenobiotus brucei estonicus E. Fefilova subsp. nov.

Figures 3 and 4

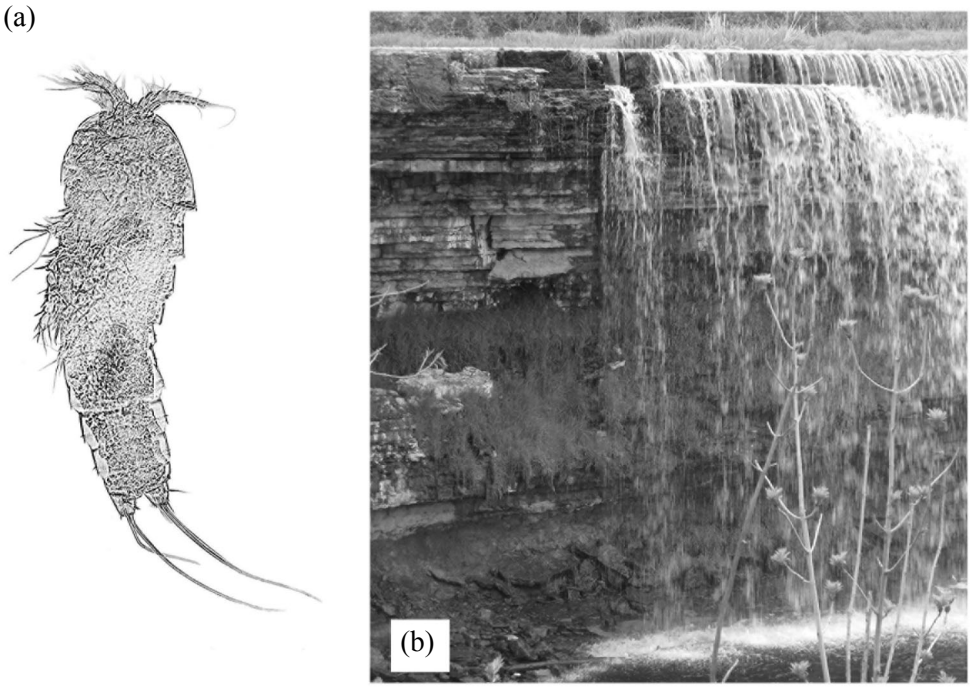

Fig. 3. Female of *Maraenobiotus brucei estonicus* subsp. nov. (a) and the biotope where this subspecies was found (b).

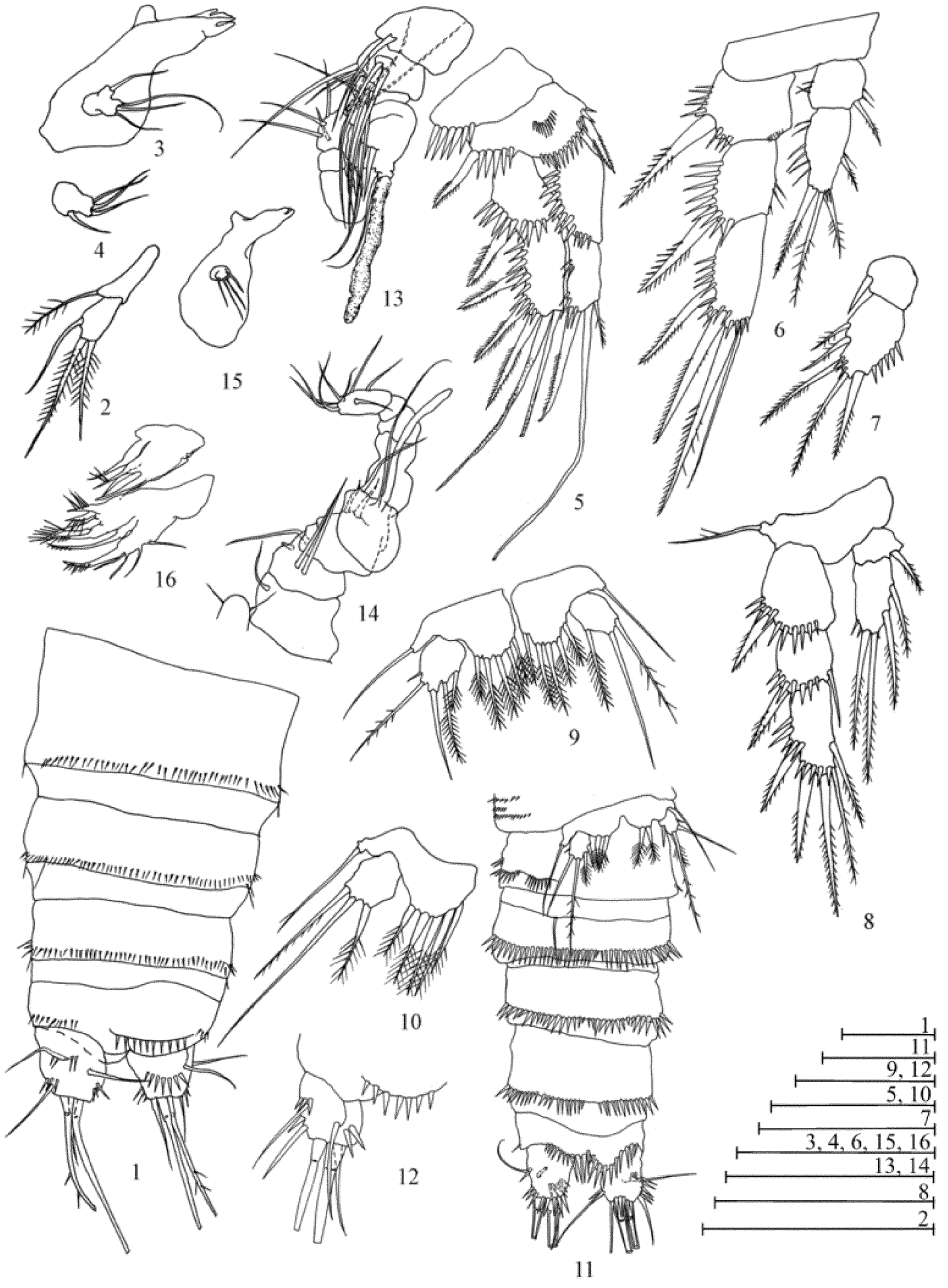

Fig. 4. *Maraenobiotus brucei estonicus* subsp. nov.: 1–9, holotype: 1 – abdomen, dorsal view; 2 – antennal exopodite; 3 – mandible; 4 – palp of mandible; 5, 6 – P1, P2; 7 – endopodite P3; 8, 9 – P4, P5; 10 – P5 of female (paratype); 11–16, male: 11 – abdomen with P5, ventral view; 12 – caudal rami and anal operculum; 13, 14 – Al; 15 – mandible; 16 – maxillae. Scale 0.05 mm.

Material examined. Holotype: female; paratypes: 20 females and 8 males, all from wet terrestrial vegetation under the waterfall on the Jägala River at Jägala-Joa, Estonia (59°27′21″ N, 25°11′04″ E), 12.05.2008; specimen of holotype (in glycerin) No. 55055, specimens (in glycerin) Nos 55056, 55057; wet material (formaldehyde) No. 55058; type collection of freshwater invertebrates of the Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia.

Description. Female (Figs 3, 4). Length from tip of rostrum to tips of caudal rami 0.6 mm. Length of caudal setae 0.2 mm. Body compact, cylindrical. Abdominal somites with continuous row of small spines edged on dorsal side. On ventral side row of spines interruptable in the middle. Anal operculum rounded, with 10 spinules. Caudal rami short and wide, as long as the last abdominal somite. Length of caudal ramus 0.036, width 0.030 mm. Ramus bearing 2 lateral setae with groups of spines near base, a row of spines on its inner and ventral sides, and 3 terminal setae. Terminal setae trivial, the medial seta 2 times longer than the lateral ones. Antennules (Al) 8-segmented. Exopodite of antenna (A2) 2-segmented with 4 setae, mandibular palp 1-segmented with 4 setae. Exopodite of legs 1 (P1) and endopodites of legs 1–4 (P1–P4) 2-segmented, exopodites of P2–P4 3-segmented. Endopodites P1 without setae, slightly longer than exopodites P1. Endopodites P2–P4 with inside seta on the first segment, shorter than exopodites. Terminal segments of endopodites bearing: P1 – 3, P2 – 4, P3 – 5, P4 – 5 setae and spines. Terminal segments of exopodites bearing: P1 – 0, 2, 3; P2 – 0, 2, 2; P3 – 1, 2, 2; P4 – 1, 2, 2 setae and spines. Medial lobe of baseoendopodites of legs 5 (P5) 2 times shorter than exopodite P5 and bearing 5 setae similar in length to that of medial lobe. The length of medial lobe 0.023, the length of exopodite 0.024, the width of exopodite 0.015 mm. Exopodite P5 rounded bearing 3–4 setae, the longest setae (0.033, 0.053 mm) without setulae.

Male (Fig. 4). Length from tip of rostrum to tips of caudal rami 0.47 mm, length of caudal setae 0.18 mm. Abdominal somites with continuous rows of spines on dorsal and ventral sides. Anal operculum with 8 spinules. On the ventral side the spines are large, their length decreases to the middle of row, but the row is not interrupted. Structure of caudal rami, A2, mandibular palp, P1 and P2 like that of female. Endopodites P3 typical of the genus. Endopodites P4 without setae on the first segment and with 2 setae on terminal segments. Medial lobe of baseoendopodites of P5 with 2 setae with setulae, inner seta slightly longer than the lateral one. Exopodite P5 rounded, bearing 4 setae. Length of the lobe of baseoendopodites P5 0.011, length of exopodite 0.011, width of exopodite 0.007 mm.

Phenotypic variability. Length of females from tip of rostrum to tips of caudal rami was 0.5–0.6 mm, length of males 0.35–0.47 mm. Number of setae on exopodite P5 was 3–4. Spinule under the first of the outward side setae on exopodite P5 was present or absent.

Differential diagnosis. According to structure of caudal rami, Al, A2, P1–P5 the taxon belongs to species *M. brucei*. In the following features, *M. brucei* subsp. nov. is different from the known subspecies of *M. brucei*: exopodite of A2 2-segmented with 4 setae, mandibular palp 1-segmented with 4 setae, the first segment of endopodite P2 with setae on inner side, abdominal somites with continuous row of spines edged on dorsal and discontinuous (of female) in the medial row of some longer spines on ventral side.

Comparison. Comparison of *M. brucei estonicus* subsp. nov. with other subspecies of *M. brucei* is presented in Table 2. Descriptions of *M. b. brucei* (Richard, 1898), *M. b. carpathicus* Chappuis, 1928, *M. b. caucasicus* Borutzky, 1934, *M. b. himalayicus* Chappuis, 1928, *M. b. malayicus* Chappuis, 1931, *M. b. africanus* Chappuis, 1936 from Borutskij (1952) are used.

Geographical distribution. Estonia.

General distribution, ecology, and biology. The nominal subspecies is widespread in the Arctic and Subarctic regions, where it inhabits large waterbodies and mosses. The other subspecies have populations in different other regions (Table 2). Cyclicity of the species probably depends on climatic factors. The subspecies *M. b. brucei* is monocyclic (Borutskij, 1952); it reproduces in the second half of summer (Fefilova, 2007) and has a diapause on the egg stage in winter (Borutskij, 1952).

Maraenobiotus sp.

Location. One female was found in the littoral of Lake Pühajarv in reedbed, on silted sand in September.

Attheyella crassa (G. O. Sars, 1862)

Location, ecology, and biology. Rivers: Väike Emajõgi, Esna, Valkla. Lakes: Pühajärv, Peipsi, Võrtsjärv, Saadjärv, Lõõdla, Maardu, Tamula, Kooraste Suurjärv. Both females and males, including copulating individuals and egg-bearing females, were collected in May and September.

General distribution and biology. Palaearctic. It inhabits regions situated to the south of the Arctics and Subarctics, and prefers large waterbodies (Borutskij, 1952). Oligosaprobic (Sarkka, 1995).

Neomrazekiella nordenskjöldi nordenskjöldi Lilljeborg, 1902

Location. One female was identified from the Roosna-Alliku Spring in September and one male from Lake Vagula in May.

General distribution and biology. The main area of this species is in the tundra zone of the Palearctics, where it lives in large and small waterbodies: lakes, springs, and pools (Borutskij, 1952; Fefilova, 2007). Polycyclic (Fefilova, 2007).

Table 2. Main differential features of the subspecies of *Maraenobiotus brucei*

Features	*M. b. estonicus*	*M. b. brucei*	*M. b. carpathicus*	*M. b. caucasicus*	*M. b. himalayicus*	*M. b. malayicus*	*M. b. africanus*
Exopodite A2	2-Segmented with 4 setae	1-Segmented with 4 setae	1-Segmented with 4 setae	1-Segmented with 4 setae	2-Segmented with 4 setae	2-Segmented	–
Mandibular palp	1-Segmented with 4 setae	1-Segmented with 5 setae	1-Segmented with 3 setae	1-Segmented with 4 setae	2-Segmented with 5 setae	2-Segmented	2-Segmented
The first segment P2	With seta	With seta	Without seta	Without seta	With seta	–	Without seta
Spines on abdominal somites	Rows of spines discontinuous in the middle on ventral side	Rows of spines discontinuous in the middle on dorsal side	–	Continuous row of spines on the first and second somites	Rows of spines discontinuous in the middle on ventral side	Rows of spines discontinuous in the middle on ventral side	Continuous row of spines on the dorsal side
Presence of additional differential features	No	No	No	No	No	Yes	Yes
Distribution	Estonia	Arctics and Subarctics	South Carpathians	Ciscaucasia	East Himalayas	Sumatra, Java	Central Africa

N. northumbrica trisetosa Schmeil, 1893

Location, ecology, and biology. Jägala River. Lakes: Pühajärv, Võrtsjärv, Saadjärv, Hino, Tamula, Viitna Pikkjärv. Females and males, including females with egg sacks, were present in samples collected both in September and May.

General distribution and biology. The subspecies is widespread in the eastern part of Europe, in Asia, and North Africa (Borutskij, 1952; Damian-Georgescu, 1970). In different types of waterbodies. Probably monocyclic (Borutskij, 1952; Fefilova, 2007).

Elaphoidella gracilis (G. O. Sars, 1862)

Location, ecology, and biology. Väike Emajõgi River. Lakes: Pühajärv, Peipsi, Võrtsjärv, Karijärv, Vagula, Maardu, Viitna Pikkjärv. Females and males were found both in spring and autumn, egg-bearing females in May.

General distribution and biology. Known only from Europe, widespread everywhere except the Arctics and the Mediterranean (lllies, 1978). In various aquatic biotopes, from rivers and lakes (Borutskij, 1952) to wet soil microhabitats (Friers & Ghenne, 2000) and interstices in dead aquatic plants (Green, 1959).

Moraria brevipes (G. O. Sars, 1862)

Location, ecology, and biology. A ditch at Lake Valguta Mustjärv, mire at Lake Valguta Valgjärv. Lakes: Viitna Pikkjärv and Käsmu. Females and males were found. In September only exuviae and diapausing individuals of this species were found. In May, adults and copepodites occurred on sandy substrata.

General distribution and biology. The species is European, typical of sphagnum bogs, occurring also in littoral of lentic waters on silty substrata and in springs (Borutskij, 1952). According to Borutskij (1952), the species is monocyclic and cold-preferring. In moderate climatic conditions occurs in winter and spring.

M. schmeili Van Douwe, 1903

Location, ecology, and biology. Lakes: Peipsi, Saadjärv, Viitna Pikkjärv. Females and males were found in May and September.

General distribution and biology. Holarctic (Rundle et al., 2000). Inhabiting small and large permanent waterbodies. In moderate climatic conditions dicyclic (Borutskij, 1952).

Epactophanes richardi Mrazek, 1894

Location. Only females were found under the waterfall on the Jägala River at Jägala-Joa on wet plants in May.

General distribution and biology. Cosmopolitan (Rundle et al., 2000). Cold-stenothermic. Capable of parthenogenetic reproduction (Dole-Olivier et al., 2000).

Family Parastenocaridae

Parastenocaris sp.

Location. One male not identified to species level was collected in the littoral of Lake Viitna Pikkjärv, on fine sand with detritus.

General distribution and biology. The genus is cosmopolitan. Species of *Parastenocaris* inhabit interstitial biotopes: wet sand and moss, as well as groundwater (Borutskij, 1952).

Harpacticoids occurred in all studied types of biotopes and waterbodies. The majority of the species were observed both in spring and autumnal samples. However, *M. brucei estonicus* subsp. nov., *E. richardi*, and *Parastenocaris* sp. were found only in May but *B. (B.) vejdovskyi* and *N. n. nordenskjöldi* only in September. These species belonged to rare ones in this study. Although *M. brucei estonicus* subsp. nov. and *E. richardi* were abundant, they were found in only one, rather specific biotope, on wet plants under a waterfall, and therefore they are characterized as stenobiotic. Other rare harpacticoid species were not abundant. The most widespread harpacticoids in the investigated region were eurybiotic. These were *N. hibernica* (in 31% of the samples), *C. s. staphylinus* (in 59% of the samples), *B. (B.) minutus* (in 45% of the samples), *Attheyella crassa* (in 33% of the samples), and *E. gracilis* (in 24% of the samples). Littorals of lakes were inhabited by 10 harpacticoid species, of which the following were widely distributed and frequent: *P. schmeili*, *B. pygmaeus*, *N. northumbrica trisetosa*, *M. brevipes*, and *M. schmeili*. Three species – *N. northumbrica trisetosa*, *M. schmeili*, and *Parastenocaris* sp. – occurred only in samples from lake littorals. In the large lakes studied, eight harpacticoid taxa were found, seven of them in Lake Võrtsjärv and also seven in Lake Peipsi. Closely-related genera *Bryocamptus* and *Echinocamptus* as well the rare *N. n. nordenskjöldi* inhabit cold-water springs.

The list of harpacticoids known from Estonia, which so far included only 5 species (Timm, 1973; Haberman, 2001), was completed with 14 species in this study, 2 of them identified to genus level only. Of these species 13 were in the list of the copepod species expected in Estonia, as suggested by Veldre & Mäemets (1956), that is indicating a relatively full knowledge of the structure of harpacticoid fauna in the investigated region. Future researches of the meiobenthic fauna of Estonian waterbodies, particularly those situated near the seashore, will probably

increase the list of harpacticoid species by oligo- and mesohalinic forms inhabiting river mouths and lagoons. Seventeen such species were expected for Estonia (Veldre & Mäemets, 1956). In European countries with extensive maritime boundaries, halophilic species account for 36–42% of the whole harpacticoid fauna (Illies, 1978; Dumont, 1989; Aagaard & Dolmen, 1996). The list of freshwater forms will increase due to finding rare forms, too, and future identification of *Maraenobiotus* sp. and *Parastenocaris* sp. found by us. In all probability, the knowledge of the composition of the harpacticoid fauna of the Estonian large lakes is yet incomplete. From Lake Ladoga, 13 harpacticoid species are known (Kurashov, 1994). Faunistic similarity according Sørensen's coefficient between these crustaceans in lakes Võrtsjärv, Peipsi, and Ladoga is 47%. Certainly it would change if harpacticoid fauna of lakes Võrtsjärv and Peipsi was studied better including the period of biological summer.

Harpacticoids as the oldest order of Copepoda (Huys & Boxshall, 1991) have a high level of endemism and quite numerous stenoecic forms. The new data about the distribution, ecology, and biology of the mass harpacticoid species of Estonia correspond to known data (Borutskij, 1952; Damian-Georgescu, 1970). A half of all species (9) are eurythermic or thermophilic and occur everywhere or widely in Europe except the tundra zone. These species are found during warm seasons in the well-warming waterbodies. The other group is defined as cold-stenothermic. In the studied region they inhabit cool springs with groundwater feeding (3 species) or other types of waterbodies, but mainly in cold seasons, surviving the summer in diapause (*C. s. staphylinus*, *M. brevipes*).

The wide distribution of *C. s. staphylinus* in Estonia confirms the repeatedly expressed opinion about the high plasticity of the species in relation to environmental quality and saprobic condition (Borutskij, 1952; Sarvala, 1979; Kurashov, 1994; Sarkka, 1995). It is known that *P. schmeili* and *A. crassa* prefer oligosaprobic waters (Sarkka, 1995), so they can serve as indicators of good water quality. A high concentration of humic compounds can be indicated by *M. brevipes* (Andronnikova, 1996).

SUMMARY

In the studied rivers, lakes, springs, and micro-waterbodies on wet plants of Estonia, 18 harpacticoid species and forms were found, 14 of them new for the local fauna. A new subspecies *Maraenobiotus brucei estonicus* E. Fefilova subsp. nov. was discovered on wet plants under the waterfall on the Jägala River at Jägala-Joa. It differs from the known six, conspecific subspecies in the combination of the following characters: structure of exopodite of antennae and mandibular palp, presence of inner seta on the first segment of legs 2, and equipment of abdominal somites. Thermophilic, cold-preferring, and eurythermic harpacticoid species occur in Estonia. The cold-preferring forms either inhabit specific biotopes or are active in cold seasons. The most widespread in the studied region, found in 24–59% of the samples, were six species and subspecies of Harpacticoida belonging to various ecological groups.

ACKNOWLEDGEMENTS

The Estonian Academy of Sciences covered my living expenses in Estonia, according to cooperation between the Estonian and Russian Academies of Sciences for reciprocal exchange of scientists. I thank Tarmo Timm, Henn Timm, and Reet Laugaste (Estonian University of Life Sciences) for help in collecting materials. I am grateful to Tarmo Timm for valuable comments and kindly checking the manuscript.

REFERENCES

Aagaard, K. & Dolmen, D. 1996. *Limnofauna Norvegica*. *Katalog over norsk ferskvannsfauna*. Tapir Forlag, Trondheim.

Afanas′eva, E. L. 1977. *Biology of* Epischura baicalensis. Nauka, Novosibirsk (in Russian).

Andronnikova, I. N. 1996. *Structured and Functional Zooplankton Organization of Lake Ecosystems*. Nauka, St. Petersburg (in Russian).

Borutskij, E. V. 1952. *Fauna of U.S.S.R. Crustacea. Freshwater Harpacticoida*. Vol. 3(4). Publishers of the Academy of Sciences of U.S.S.R., Moskva–Leningrad (in Russian).

Damian-Georgescu, A. 1970. *Fauna Republicii Socialiste Romania. Crustacea. Volumul IV. Fascicula 11. Copepoda. Harpacticoida*. Editura Academiei Republicii Socialiste Romania, Bucharest.

Dole-Olivier, M.-J., Galassi, D. M. P., Marmonier, P. & Creuze des Chatelliers, M. 2000. The biology and ecology of lotic micro crustaceans. *Freshwater Biol.*, **44**, 63–91.

Dumont, H. 1989. The free-living fresh- and brackish-water copepods of Belgium. In *Proc. Symp. Invert. of Belgium*, pp. 147–151.

Fefilova, E. 2007. Seasonal development of harpacticoid copepods in the North-East of European Russia. *Fund. Appl. Limnol./Arch. Hydrobiol.*, **170**, 65–75.

Friers, F. & Ghenne, V. 2000. Cryptozoic copepods from Belgium: diversity and biogeographic implications. *Belg. J. Zool.*, **130**, 11–19.

Green, J. 1959. Hemoglobin and the habitat of the harpacticoid copepod *Elaphoidella gracilis* (Sars). *Nature (Engl.)*, **183**, 1834.

Haberman, J. 2001. Zooplankton. In *Lake Peipsi. Flora and Fauna* (Pihu, E. & Haberman, J., eds), pp. 50–68. Sulemees Publishers, Tartu.

Huys, R. & Boxshall, G. A. 1991. *Copepod Evolution*. The Ray Society, London.

Illies, J. 1978. *Limnofauna Europaea*. Gustav Fischer Verlag, Stuttgart, New York & Zeittinger, Amsterdam.

Järvet, A. 2004. Hydrology of Lake Võrtsjärv. In *Lake Võrtsjärv* (Haberman, J., Pihu, E. & Raukas, A., eds), pp. 105–139. Estonian Encyclopaedia Publishers, Tallinn.

Kurashov, E. A. 1994. *Meiobenthos as a Component of Lake Ecosystem*. Institute of Limnology of RAS, St. Petersburg (in Russian).

Rundle, S. D., Bilton, D. T. & Shiozawa, D. K. 2000. Global and regional patterns in lotic meiofauna. *Freshwater Biol.*, **44**, 123–134.

Sarkka, J. 1995. Profundal meiofauna in two large lakes: influence of pollution and bathymetric differences. *Arch. Hydrobiol.*, **132**, 453–493.

Sarvala, J. 1979. A parthenogenetic life cycle in a population of *Canthocamptus staphylinus* (Copepoda, Harpacticoida). *Hydrobiologia*, **62**, 113–129.

Sarvala, J. 1990. Complex and flexible life history of a freshwater benthic harpacticoid species. *Freshwater Biol.*, **23**, 523–540.

Sørensen, T. 1948. A method of establishing groups of equal amplitude in plant sociology based on similarity of species content and its application to analyses of the vegetation on Danish commons. *Biol. Skr.*, **5**, 1–34.

Timm, T. (ed.) 1973. *Võrtsjärv*. Valgus, Tallinn.

Timm, T. 2002. Meiobenthos in some Estonian small stratified lakes. *Proc. Estonian Acad. Sci. Biol. Ecol.*, **51**, 184–203.

Veldre, I. & Mäemets, A. 1956. *Eesti NSV vabaltelavad aerjalalised (Eucopepoda) II. Sõudikulised (Cyclopoida), rullikulised (Harpacticoida). Abiks loodusevaatlejale 29*. Loodusuurijate Selts Eesti NSV Teaduste Akadeemia juures, Tartu.

Rullikuliste (Crustacea, Copepoda, Harpacticoida) liigid ja nende levik Eesti mageveekogudes

Elena Fefilova

On kirjeldatud esmakordselt 18 rullikulise liigi levikut Eestis. Loomad koguti mais ja septembris väikestest mageveekogudest veelembeste taimede vahelt ning Peipsi ja Võrtsjärve sügavamatest osadest ka järvemudast. Leitud rullikulised kuuluvad termofiilsete, külmalembeste ja eurütermsete ökoloogilisse rühma. Uus rullikuliste alamliik *Maraenobiotus brucei estonicus* E. Fefilova subsp. nov. leiti kose alt märgade taimede vahelt. Leitud alamliik eristub varem tuntud *M. brucei* alamliikidest tundla eksopodiidi, lõugkobija, teise jala endopodiidi ja tagakeha selgmiste ogade ehituse alusel.