Ann. Zool. Fennici 22: 123-127. 1985

The occurence of water mites (Acari: Hydrachnellae) in the estuary of the River Kyrönjoki (Bothnian Bay)

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Bagge, P. & Meriläinen, J. J. 1985: The occurence of water mites (Acari: Hydrachnellae) in the estuary of the River Kyrönjoki (Bothnian Bay). — Ann. Zool. Fennici 22:123-127.

The occurrence of water mites in the estuary of the River Kyrönjoki, in the southern Bothnian Bay (63°20'N), was examined during the summers of 1980-1982. The material, sampled using different methods, consisted of 1812 specimens and 30 species, nine of which were new to the coastal waters of Finland. *Unionicola aculeata* and *Arrenurus sinuator* have not been previously reported from Finnish waters. Water mites occurred most abundantly in shallow parts of the transition zone of the estuary with varying salinities. The previously documented harmful influence of the acid river waters on many aquatic animals in the innermost, limnic zone was also pronounced on water mites. Only three species were living in the limnic zone, 29 species in the transition zone and seven species in the outermost, brackish water zone.

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1. Introduction

The occurrence of water mites in the coastal waters of the Gulf of Finland was studied by Nordenskiöld (1894 and 1897) and on the Swedish side of the Gulf of Bothnia by Svenonius (1949) and Viets (1979). Scattered remarks on the occurrence of water mites in some brackish water lakes and in the Archipelago Sea are also included in the paper of Bagge & Tulkki (1967), though usually the group has not been dealt with in zoobenthic studies, indicating that water mites in the Baltic Sea are absent or at least very rare in the more saline parts and on deep bottoms.

During the summers of 1980 and 1981, the junior author took bottom samples using an Ekman-Birge grab, bottom sledges and hand-net twice a year in different areas and depths of the Kyrönjoki estuary (Meriläinen 1984a). The results showed that the estuary was clearly zoned, both hydrographically and faunistically, including a fresh-water zone with very low pH and impoverished fauna, a transition zone with periodically varying pH and salinities ($S = 0\text{-}3\ ^0/_{00}$) and a relatively rich fauna consisting mainly of limnic species and, lastly, a more stable brackish water zone ($S = 3\text{-}4\ ^0/_{00}$) dominated by brackish water species at least on deeper bottoms. In the two outermost zones, several species of water mites were sampled, but in the innermost, acidified area only one Hydracarina species (*Limnochares aquatica*) could be detected. In order to ascertain the details of the zonation of water mites, several series of plexiglass trap samples were collected in different parts of the estuary in July - August, 1982. The method, in which the traps are placed on the bottom for 24 hours, effectively collects all actively moving small animals and is especially suitable for catching water mites in lentic waters (Bagge 1979a).

2. Study area

The River Kyrönjoki drains into the southern part of the Bothnian Bay, initially as a shallow (about 3 m) and narrow estuary extending about ten kilometres to the Nabben region, to the east and west of which lie the bays

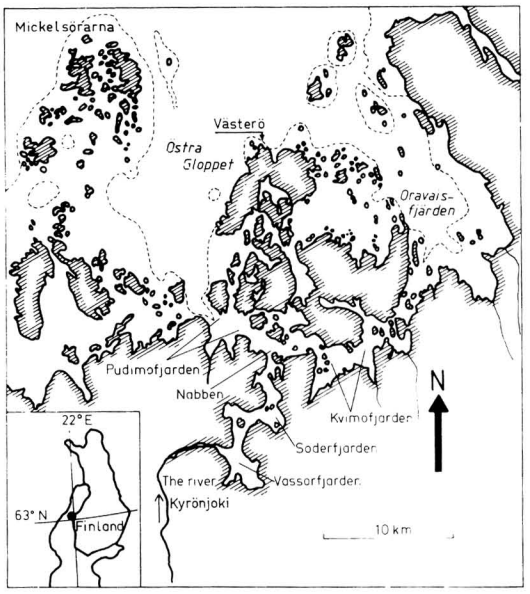

Fig. 1. The Kyrönjoki estuary. Isobath of 10 m is marked with a broken line.

Kvimofjärden and Pudimofjärden (Fig. 1). Kvimofjärden, a shallow (about 3 m), sheltered area, is connected to the bay of Oravaisfjärden through a narrow sound. The deeper (7–10 m) western branch, Pudimofjärden, opens into the wider brackish water area, Östra Gloppet.

The river has a watershed area of 4900 km^2 and a mean flow of 45 m^3/s. The estuary is mainly loaded by intensive agriculture, practised along the course of the river, and municipal waste water. The annual means of total phosphorus and COD in the river water are c. 100 μg/l and 27 mg O_2/l, corresponding to average annual loads of 154 tons phosphorus and 37 000 tons organic matter (Meriläinen 1985). The lower reaches of the river flow through the sulphurous soil deposited during the previous phase of the Baltic Basin, about 6000–1500 BC. Even in very low concentrations, the highly acid runoff waters of these areas, where sulphuric acid is produced from the sulphurous compounds of the soil, acidify the poorly buffered river water. Acidity (pH below 5) is intermittent, lasting from several days to some weeks at a time, especially during and after flood times. The upper estuary (Vassorfjärden – Nabben) is characterised by a very impoverished bottom fauna but luxuriant aquatic vegetation (Meriläinen 1984a, b).

On hydrographical grounds three zones can be distinguished in the estuary. The area from Vassorfjärden to Söderfjärden belongs to the limnic zone, while Söderfjärden, Nabben, Kvimofjärden and Pudimofjärden make up the transition zone, where the river water is always discernible at least in the surface layer (Table 1). The hydrographic data presented in Table 1 are based on the measurements made by the Water District Office of Vaasa during 1983 and 1984. The outermost zone (including Östra Gloppet and the Oravaisfjärden bay) is an α-oligohaline (salinity 3.5–4.0 ‰) zone where river water is observable only occasionally in the inner regions at times of ice cover and floods.

Table 1. Range of the river water percentage, colour of water (mg Pt/l) and pH near the surface (0–3 m) and at depths of 3–7 m in different parts of the estuary (see Fig. 1). Observations between 7.III.1983 and 16.V.1984 (unpublished data). Values for Östra Gloppet were measured at the station near the Island of Västerö.

	% river water		Colour		pH	
Water layer:	0–3	3–7	0–3	3–7	0–3	3–7
Vassor-fjärden	80–100	·	100–350	·	4.1–7.2	·
Söder-fjärden	35–100	·	85–240	·	4.6–7.6	·
Nabben	20–100	10–45	75–190	40–110	4.7–7.7	6.2–7.8
Kvimo-fjärden	10–86	·	15–80	·	4.7–7.8	·
Pudimo-fjärden	3–63	0–12	20–140	15–30	5.3–8.0	7.1–8.0
Östra Gloppet	0–30	0–15	10–60	10–30	7.2–8.1	7.8–8.1

Table 2. Number of localities sampled with different sampling gears during different periods (months) in different areas of the estuary of Kyrönjoki.

Gear:	Sledge	Handnet	E-B grab sieve	Plexi-glass traps
Mesh size (mm):	1.0	0.6	0.6	0.4
Period:	Aug. 1980 – June 1981		June, Aug. 1980	July–Aug. 1982
Vassorfjärden	3	3	5	10
Söderfjärden	2	2	–	10
Nabben	5	5	4	23
Kvimofjärden	4	4	3	10
Pudimofjärden	4	1	5	17
Östra Gloppet	10	4	5	7
Oravaisfjärden	5	4	5	–

3. Material and methods

The material from the estuary consists of 1812 individuals of water mites (Table 3). The nomenclature presented is mainly according to Viets (1978), but here *Piona rotundoides*, *P. stjoerdalensis* and *P. dispersa* (which have formerly been considered as forms of *P. pusilla*, *P. coccinea* or *P. variabilis*) are considered as distinct species.

The main part (c. 90 %) of the material was collected by means of plexiglass traps (cf. Bagge 1979a) and the rest with an Ekman-Birge grab, bottom sledges and a handnet. The sampling method, sampling periods and number of sampling localities in the estuary are presented in Table 2. Since the number of localities sampled by means of traps is relatively small in the two outermost areas, the results from Östra Gloppet and Oravaisfjärden have been combined in spatial comparisons.

Table 3. List of Hydracarina and number of males (M), females (F) and nymphs (N) caught in the estuary of Kyrönjoki.

	M	F	N		M	F	N
Limnochares aquatica (L.)		2	-	*Piona longipalpis* (Krend.)	1	3	2
Hydrodroma despiciens (Müll.)	1	1	-	*P. pusilla* (Neum.)	9	137	41
Lebertia brigantina Viets		1	-	*P. rotundoides* (Thor)	3	3	1
Limnesia maculata (Müll.)	282	280	89	*P. stjoerdalensis* (Thor)	38	11	1
L. undulata (Müll.)	10	12	-	*P. variabilis* (Koch)	5	1	-
Hygrobates fluviatilis (Ström)	2	24	-	Undet. *Piona*-specimens	-	1	7
H. longipalpis (Herm.)	17	41	9	*Hydrochoreutes krameri* Piers.	-	1	9
H. nigromaculatus Leb.	7	23	2	*Forelia liliacea* (Müll.)	50	74	40
Unionicola aculeata (Koen.)	68	39	12	*F. longipalpis* Maglio	1	1	-
U. crassipes (Müll.)	1	4	1	*F. variegator* (Koch)	1	2	1
U. minor (Soar)	2	5	4	*Brachypoda versicolor* (Müll.)	1	42	1
Undet. *Unionicola*-nymphs	-	-	9	*Mideopsis orbicularis* (Müll.)		195	15
Neumania deltoides (Piers.)	21	11	65	*Arrenurus* sp.	-	1	-
Piona brehmi Walt.	-	7	-	*A. crassicaudatus* Kram.	31	7	4
P. coccinea (Koch)	2	3	-	*A. nobilis* Neum.	1	1	-
P. dispersa Sok.	-	3	2	*A. sinuator* (Müll.)	7	-	-

Table 4. The occurrence of Hydracarina (total number of specimens observed) in littoral (L) and sublittoral + profundal samples (P) from different zones of the Kyrönjoki estuary.

	Vassor-fjärden	Söder-fjärden	Nabben		Kvimo-fjärden		Pudimo-fjärden		Outermost zone		Depth range (m)
	L	L	L	P	L	P	L	P	L	P	
Limnochares aquatica	1	-	-	-	-	-	1	-	-	-	0-1
Hydrodroma despiciens	-	-	-	-	2	-	-	-	-	-	0.5-1.7
Lebertia brigantina	-	-	-	-	1	-	-	-	-	-	3
Limnesia maculata	-	18	168	36	413	-	16	-	-	-	0.5-3.7
L. undulata	-	-	-	-	16	-	3	1	2	-	0.5-6.5
Hygrobates fluviatilis	-	-	-	-	-	-	-	-	26	-	1-4[1]
H. longipalpis	-	-	-	-	20	-	15	-	30	2	0.5-25
H. nigromaculatus	-	-	-	4	4	-	21	2	1	-	0.5-3.8
Unionicola aculeata	-	1	52	1	65	-	1[2]	-	-	-	0.5-5
U. crassipes	-	-	-	-	5	-	1	-	-	-	0.5-3
U. minor	-	-	-	-	11	-	-	-	-	-	0.5-1.7
Undet. *Unionicola*-nymphs	-	1	-	-	8	-	-	-	-	-	0.5-1.7
Neumania deltoides	-	1	2	3	79	3	9	-	-	-	0.5-5
Piona brehmi	-	-	4	-	2	-	1	-	-	-	0.5-3
P. coccinea	-	-	5	-	-	-	-	-	-	-	0.6-1.5
P. dispersa	4	-	-	-	1	-	-	-	-	-	0.5-1.7
P. longipalpis	-	6	-	-	-	-	-	-	-	-	0.7-1.5
P. pusilla	-	-	48	6	125	-	8	-	-	-	0.5-5
P. rotundoides	-	-	7	-	-	-	-	-	-	-	0.6-1.5
P. stjoerdalensis	-	1	3	1	45	-	-	-	-	-	0.5-3.5
P. variabilis	-	2	4	-	-	-	-	-	-	-	0.6-1.5
Undet. *Piona-specimens*	-	-	-	-	6	-	1	-	1	-	0.5-2.5
Hydrochoreutes krameri	1	6	1	-	2	-	-	-	-	-	0.5-2
Forelia liliacea	-	1	62	11	80	1	9	-	-	-	0.5-8
F. longipalpis	-	-	1	-	1	-	-	-	-	-	0.5-1.7
F. variegator	-	1	-	2	-	-	1	-	-	-	0.7-3.5
Brachypoda versicolor	-	-	23	1	5	-	15	-	-	-	0.5-3.7
Mideopsis orbicularis	-	-	19	10	125	3	46	1	5	1	0.5-10
Arrenurus crassicaudatus	-	-	1	7	4	-	24	4	2	-	0.5-9
A. nobilis	-	-	1	-	-	-	1	-	-	-	0.6-3
A. sinuator	-	-	3	-	1	-	3	-	-	-	0.6-3
Arrenurus sp.	-	-	-	-	-	-	1	-	-	-	5
Sum of taxa	3	10	18		21		18		7		
Sum of specimens	6	38	486		1028		184		70		

[1] Stony bottom. [2] Dead.

4. Results

4.1. The composition of the Hydrachnid fauna

Altogether 30 species of water mites were detected in the material (Table 3). Most of the specimens trapped in July - August were adults but the number of nymphs was high at least in the populations of *Limnesia maculata, Neumania deltoides, Piona pusilla* and *Forelia liliacea,* which were also the most abundant species in the material. Females dominated in the populations of *Hygrobates* spp., *Piona pusilla* and *Brachypoda versicolor* and males in the populations of *Piona stjoerdalensis, Arrenurus crassicaudatus* and probably also in *Mideopsis orbicularis,* though the sexes of this species were not separated in all samples.

4.2. The zonation of species and individuals

Water mites occurred in the littoral samples (0-3 m) in all parts of the estuary (Table 4), while only a few species and individuals were found on deeper soft bottoms. The species frequently found outside the vegetation zones were *Hygrobates longipalpis, Piona pusilla, Forelia liliacea, Mideopsis orbicularis* and *Arrenurus nobilis.* Characteristic features in the horizontal distribution of the species and individuals were: 1) the very low occurrence in the acidified limnic zone (Vassor-Söderfjärden); 2) a clear maximum in the transition zone (Nabben-Kvimofjärden); and 3) a considerable decrease in numbers in the α-oligohaline zone (Oravaisfjärden - Östra Gloppet). Most of the species had their maximum occurrence in the transition zone; only *Piona dispersa* was most common in the limnic zone and *Hygrobates fluviatilis* and *H. longipalpis* in the outermost zone.

5. Discussion

The composition of the Hydrachnid fauna, especially in the transition zone of the Kyrönjoki estuary, is much like that found in large lakes of central and eastern Finland (cf. Bagge 1979b, 1983) or in the β-oligohaline parts of the Bothnian Bay (Svenonius 1949), but there are some minor deviations. Svenonius (1949) mentions several species, including *Limnesia koenikei, Hygrobates trigonicus, Pionacercopsis vatrax* and *Piona conglobata* in the archipelago of Luleå, but they were absent from our material. On the other hand, common species in the transition zone of the Kyrönjoki estuary, *Unionicola aculeata* and *Arrenurus sinuator,* are new to Finland's fauna and there are no earlier records of *Lebertia brigantina, Hygrobates fluviatilis, Unionicola minor, Piona brehmi, P. stjoerdalensis, Forelia longipalpis* and *F. variegator* in the Bothnian Bay or in the coastal waters of Finland. In particular, the rich occurrence of *Unionicola aculeata* in the estuary of Kyrönjoki is somewhat problematical, since the development of the postlarvae occurs in freshwater mussels (cf. Koenike 1915, Lundblad 1968, Hevers 1980), and the mussel fauna of the innermost parts of the estuary is poor (Meriläinen 1984a and Table 5).

The vertical distribution of water mites in the Kyrönjoki estuary seems to be somewhat more depressed than that found in large Finnish lakes during summer (cf. Bagge 1979b), since only a few species and individuals have been found outside the vegetation zones. The phenomenon is most clearly seen in the deeper outermost parts of the area and may depend on higher salinity and/or absence of suitable hosts for the larvae of water mites in deeper waters.

The horizontal zonation of water mites in the Kyrönjoki estuary is very peculiar, but does not deviate much from that found in some other zoobenthic groups in the area (Table 5).

Thus the impoverishment of the fauna caused by acidity and reduced conditions in the sediments is clearly seen also in the numbers of Hydracarina in the innermost parts of the area, and a richer occurrence is first encountered at c. 10-15 km from the river mouth. In the transition zone, especially in the shallow Kvimofjärden, the numbers of water mites were especially high (mean number of specimens/trap/24 h = 98) while the corresponding figure in Vassorfjärden was 0.5, in Söderfjärden 3.8, in Nabben 28.5 and in the littoral zone of Pudimofjärden 11.4. The few trap samples taken in the littoral of the α-oligohaline area indicate that the number of water mites is very low, c. 3-4 specimen /trap/24 h, but the material is too scanty for more exact evaluations. Also the number of

Table 5. Species number of water mites (this study) and some other macrozoobenthic groups in different parts of the estuary (observations from Meriläinen 1984 augmented by this study).

	Limnic zone	β-oligohaline zone				α-oligo haline zone
	Vassorfjärden + river mouth	Söder-fjärden	Nabben	Kvimo-fjärden	Pudimo-fjärden	
Hydracarina	3	10	18	21	18	7
Mollusca	-	1	4	6	6	7
Oligochaeta	6	••	3	4	10	7
Crustacea	1	1	4	3	8	12
Ephemeroptera	-	-	2	3	2	2
Diptera	17	••	18	24	30	32

species in the outermost area could be raised with more intensive collections, since Nordenskiöld (1894, 1897) mentions not less than 12 species of Hydracarina occurring in the Ramsösund area (Gulf of Finland), where the salinity of the surface water is c. 5 ‰.

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Received 17.X.1984
Printed 11.VII.1985