Polar Biol (2012) 35:1013–1026
DOI 10.1007/s00300-011-1149-0

ORIGINAL PAPER

Tardigrada of the Revdalen (Spitsbergen) with the descriptions of two new species: *Bryodelphax parvuspolaris* (Heterotardigrada) and *Isohypsibius coulsoni* (Eutardigrada)

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Received: 22 June 2011 / Revised: 17 December 2011 / Accepted: 19 December 2011 / Published online: 19 January 2012

Abstract Despite a century long history of research, tardigrade fauna of the Svalbard Archipelago remains poorly known. In order to deepen our knowledge of tardigrade biodiversity in the Arctic, we collected forty-one moss and lichen samples from the Revdalen and on the south-east slopes of the Rotjesfjellet (Spitsbergen, Svalbard Archipelago) in June 2010. In these samples, twenty-five tardigrade species were found, including two new for science: *Bryodelphax parvuspolaris* sp. nov. and *Isohypsibius coulsoni* sp. nov. *B. parvuspolaris* sp. nov. belongs to the *weglarskae* group but differs from all other species of the group by a unique configuration of ventral plates. *I. coulsoni* sp. nov. differs from the most similar species *I. ceciliae* Pilato and Binda, 1987 mainly by the absence of ventral sculpture. Two additional species, *Milnesium asiaticum* Tumanov, 2006 and *Diphascon* (*Adropion*) *prorsirostre* Thulin, 1928, are recorded from the Svalbard Archipelago for the first time.

Keywords Arctic · Faunistics · New records · Tardigrada · Taxonomy · Biodiversity

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Introduction

Although the first studies on water bears (Tardigrada) of the Svalbard Archipelago took place as early as in the nineteenth century (Scourfield 1897) and were continued by a number of researchers throughout the twentieth century (e.g. Richters 1903, 1904, 1911; Murray 1907; Marcus 1928; Węglarska 1965; Dastych 1985; Pugh and McInnes 1998; Łagisz 1999), our knowledge about the tardigrade fauna of this region is still relatively poor. The most comprehensive work on Spitsbergen tardigrades (Dastych 1985) provided a complete species list, new records and also investigated the ecology of these microscopic invertebrates. A decade later, Pugh and McInnes (1998) analysed the origin of the Arctic Tardigrada. Other papers were published sporadically, and the majority were limited to reports and descriptions of new species from the Svalbard Archipelago (e.g. Binda et al. 1980; Pilato et al. 1982; Dastych 1983; De Smet et al. 1987, 1988; Pilato and Binda 1987; Van Rompu and De Smet 1988, 1991, 1994; De Smet and Van Rompu 1994; Maucci 1996; Tumanov 2007; Smykla et al. 2011). In the region of Hornsund, studies were previously conducted by Węglarska (1965), Dastych (1985), Maucci (1996), Janiec (1996) and Łagisz (1999). Up to now, only 84 species were recorded from the

Svalbard Archipelago, but none specifically from the Revdalen (Coulson 2011).

Here, we provide a list of tardigrades species from the Revdalen, including two new records from the Svalbard Archipelago and descriptions of two species new for science, *Bryodelphax parvuspolaris* sp. nov. and *Isohypsibius coulsoni* sp. nov. The genus *Bryodelphax* consists of only 17 species, but its distribution is global—it has been recorded from the polar regions to tropical rain forests (Kaczmarek and Michalczyk 2004; Kaczmarek et al. 2005; Kristensen et al. 2010; Degma et al. 2011). In contrast, the genus *Isohypsibius* is one of the largest in the phylum Tardigrada, with more than 130 species and subspecies described from all over the world (McInnes 1994; Degma et al. 2011).

Materials and methods

Moss and lichen samples for this study were collected from the Revdalen and the Rotjesfjellet, which are located on the north coast of Hornsund (Spitsbergen, Svalbard Archipelago; Fig. 1). The total of forty-one moss and lichen samples were collected on the 26th June 2010 from the Revdalen and on the 29th June 2010 from the south-east slopes of the Rotjesfjellet (see Table 1). Twenty-nine (over 70%) of the samples provided a total of 461 specimens and 83 eggs.

All specimens and eggs were mounted on microscopic slides in Hoyer's medium and then examined and photographed with a Phase Contrast Microscope (PCM). Species were identified using the key to the World Tardigrada (Ramazzotti and Maucci 1983) and original descriptions from the literature.

All measurements are given in micrometres (μm). Structures were measured only if their orientations were suitable. Body length was measured from the anterior to the posterior end of the body, excluding the hind legs. Measurements of the species used in differential diagnoses are given or calculated according to the original descriptions (i.e. Pilato 1972, 1974; Bertolani et al. 1995; Kristensen et al. 2010). Claws of *Isohypsibius coulsoni* sp. nov. were measured according to Beasley et al. (2008).

In eutardigrades, the *pt* ratio is the ratio of the length of a given structure to the length of the buccal tube, expressed as a percentage (Pilato 1981). Similarly, to provide relative measurements in echiniscids, the *sc* ratio of the length of a given structure to the length of the scapular plate is used (e.g. Fontoura and Morais 2011). Both values are always

Table 1 The list of localities in the Hornsund area, from which samples containing tardigrades were collected

Locality no.	Locality name and coordinates	Plant	Substrate	m asl
I	Northern part of the Revdalen, near the Revvatnet and the Revelva (77°01′29″N; 15°22′39″E)	Moss	Rock	51
II–IV	Northern part of the Revdalen, near the Revvatnet and the Revelva (77°01′41″N; 15°22′21″E)	Moss	Soil	67
V	Northern part of the Revdalen, near the Revvatnet and the Revelva (77°01′41″N; 15°22′21″E)	Moss	Rock	67
VI–VIII	Northern part of the Revdalen, near the Revvatnet and the Revelva (77°01′39″N; 15°22′47″E)	Moss	Rock	76
IX	Northern part of the Revdalen, near the Revvatnet and the Revelva (77°01′34″N; 15°23′12″E)	Moss	Rock	76
X	Northern part of the Revdalen, near the Revvatnet and the Revelva (77°01′26″N; 15°23′30″E)	Moss	Soil	68
XI	Northern part of the Revdalen, near the Revvatnet (southern edge) and the Revelva (77°01′09″N; 15°24′34″E)	Moss	Rock	50
XII–XIII	Northern part of the Revdalen, near the Revvatnet (southern edge) and the Revelva (77°01′09″N; 15°24′34″E)	Moss	Soil	50
XIV	Northern part of the Revdalen, near the Revvatnet (southern edge) and the Revelva (77°01′09″N; 15°24′34″E)	Moss, lichen	Soil	50
XV	The Revdalen, south-east of the Revvatnet and the Revelva (77°00′35″N; 15°28′20″E)	Moss	Soil	36
XVI	The Revdalen, south-east of the Revvatnet and the Revelva (77°00′22″N; 15°29′02″E)	Moss	Soil	29
XVII–XVIII	The Rotjesfjellet, south-east slope (77°00′16″N; 15°24′02″E)	Moss	Soil	50
XIX–XX	The Rotjesfjellet, south-east slope (77°00′19″N; 15°23′55″E)	Moss	Soil	100
XXI–XXII	The Rotjesfjellet, south-east slope (77°00′26″N; 15°23′42″E)	Moss	Soil	201
XXIII	The Rotjesfjellet, south-east slope (77°00′29″N; 15°23′35″E)	Moss	Soil	250
XXIV	The Rotjesfjellet, south-east slope (77°00′31″N; 15°23′21″E)	Moss	Soil	301
XXV	The Rotjesfjellet, south-east slope (77°00′31″N; 15°23′21″E)	Moss, lichen	Soil	301
XXVI–XXVII	The Rotjesfjellet, south-east slope (77°00′35″N; 15°22′58″E)	Moss	Rock	399
XXVIII–XXIX	The Rotjesfjellet, the top (77°00′40″N; 15°22′20″E)	Moss	Rock	437

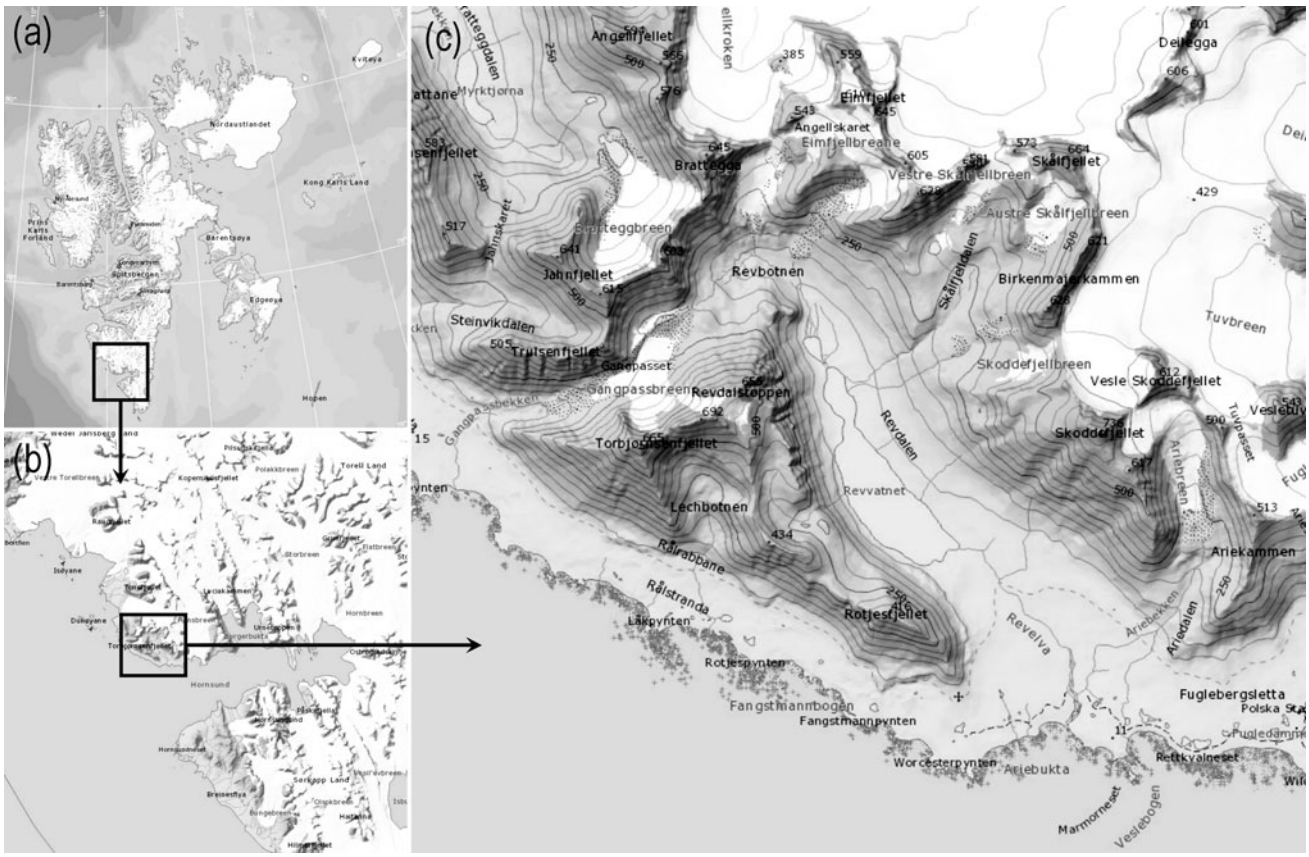


Fig. 1 The study area: **a** Svalbard Archipelago **b** Hornsund, West Spitsbergen, **c** Revdalen and Rotjesfjellet (maps from Norsk Polarinstitute)

provided in italics, in order to differentiate them from other measurements and ratios.

The configuration of ventral plates in the genus *Bryodelphax* is described using an analogous system to that used for the description of cuticular gibbosities in some eutardigrades (Michalczyk and Kaczmarek 2010), i.e. a Roman number with a colon at the beginning of the sequence indicates the total number of rows of ventral plates and following Arabic numbers separated by dashes refer to the numbers of plates in each row, starting from the most anterior row.

All the investigated material is preserved in the collection of the first author, at the Department of Animal Taxonomy and Ecology, A. Mickiewicz University, Poznań, Poland.

Results

Taxonomic accounts of the new species found in the study

Bryodelphax parvuspolaris sp. nov. (Figs. 2–8; Table 2)

Material examined Holotype (female) (slide 14.2/20) and 8 paratypes (females) (slides: 14.2/4, 14.2/8, 14.2/9, 14.2/12, 14.2/13, 14.2/14, 14.2/16, 14.2/19).

Description (measurements in Table 2) Body (Figs. 2–4) transparent to slightly rose, eyes absent or not visible after the preparation. Apart from the head appendages (cirrus *internus* and *externus* and drop-shaped cephalic papillae (secondary clava)), only lateral cirrus *A* (with clava near the base (primary clava) present).

Dorsal plates covered with fine, but distinct dark dots that appear as granulation under PCM, but are in fact cuticular pillars within cuticle (Michalczyk and Kaczmarek 2006, 2007). "Granulation" distinctly larger on the scapular and the terminal plate. In addition to the "granulation", slightly larger and irregularly distributed pores are visible mainly on the margins of all dorsal plates (Fig. 5). Scapular plate facetted with a median longitudinal fold and a few smaller transverse folds. Paired plates divided into two unequal anterior and posterior parts by a transverse stripe without "granulation". Median plates 1 and 2 divided, and median plate 3 undivided. Twelve supplementary plates poorly visible near median plates 1–3. The terminal plate facetted with two longitudinal folds.

Ventral plates arranged in eight rows: 1 plate in row I (between legs I), 1 plate in row II (between legs I and II), 2 plates in row III (between legs I and II), 2 plates in row IV (between legs II), 2 plates in row V (between legs II and III), 2 plates in row VI (between legs III), 2 plates in row

Table 2 Measurements and *sc* values of selected morphological structures of nine specimens (including the holotype) from the type population of *Bryodelphax parvuspolaris* sp. nov.

Character	N	Range		Mean		SD		Holotype	
		µm	*sc*	µm	*sc*	µm	*sc*	µm	*sc*
Body length	9	87–125	*523–556*	110	*542*	11	*17*	122	*546*
Scapular plate length	3	16.7–22.3	–	19.6	–	2.8	–	22.3	–
Head appendages lengths									
Cirrus *internus*	7	4.4–7.3	*22.4–26.3*	5.5	*24.3*	1.1	*2.7*	5.0	*22.4*
Cephalic papilla	6	2.4–4.0	*15.2–17.9*	2.9	*16.5*	0.6	*2.0*	4.0	*17.9*
Cirrus *externus*	7	9.0–16.1	*52.5–57.6*	11.8	*55.0*	2.2	*3.6*	11.7	*52.5*
Clava	8	1.4–4.2	*14.1–18.8*	2.7	*16.5*	0.9	*3.3*	4.2	*18.8*
Cirrus *A*	8	22.9–37.4	*144.4–164.6*	29.9	*154.5*	5.0	*14.3*	32.2	*144.4*
Cirrus *A*/Body length ratio	8	21%–32%	–	27%	–	5%	–	26%	–
Cirrus *int/ext* length ratio	7	43%–53%	–	47%	–	3%	–	43%	–
Claw 4 lengths									
Branch	9	4.5–6.3	*26.9–31.8*	5.6	*28.6*	0.6	*2.8*	6.0	*26.9*
Spur	9	0.7–1.3	*3.5–4.9*	0.9	*4.4*	0.2	*0.8*	1.1	*4.9*
Spur/branch length ratio	9	11%–22%	–	16%	–	3%	–	18%	–

N number of specimens or structures measured, *Range* the smallest and the largest structure found among all specimens measured, *SD* standard deviation, *sc* ratio of the length of a given structure to the length of the scapular plate, expressed as a percentage

VII (in line with the gonophore) and 1 plate in row VIII (below the gonophore); i.e. the ventral plate configuration VIII:1-1-2-2-2-2-2-1 (Figs 4, 8). All ventral plates with fine and indistinct "granulation" (Fig. 6).

Spine on legs I and papilla on legs IV absent or not visible under PCM. Collar on legs IV with poorly developed and irregular teeth. External claws of all legs smooth, internal claws with very small spurs directed downwards (Fig. 7).

Eggs unknown.

Remarks In some specimens, ventral plates are indistinct; thus, an examination of at least several specimens to ensure correct identification is strongly recommended.

Etymology The name '*parvuspolaris*', meaning 'a small dweller from the polar regions', was chosen by the participants of the XXXIII Polar Expedition of the Polish Academy of Sciences, who provided us with logistical support and helped collecting samples from Spitsbergen.

Type locality Hornsund, northern part of the Revdalen, near the Revvatnet and the Revelva, mosses from soil, 67 m asl, 77°01′41″N, 15°22′21″E, 26.06.2010, coll. Łukasz Kaczmarek and Jerzy Smykla.

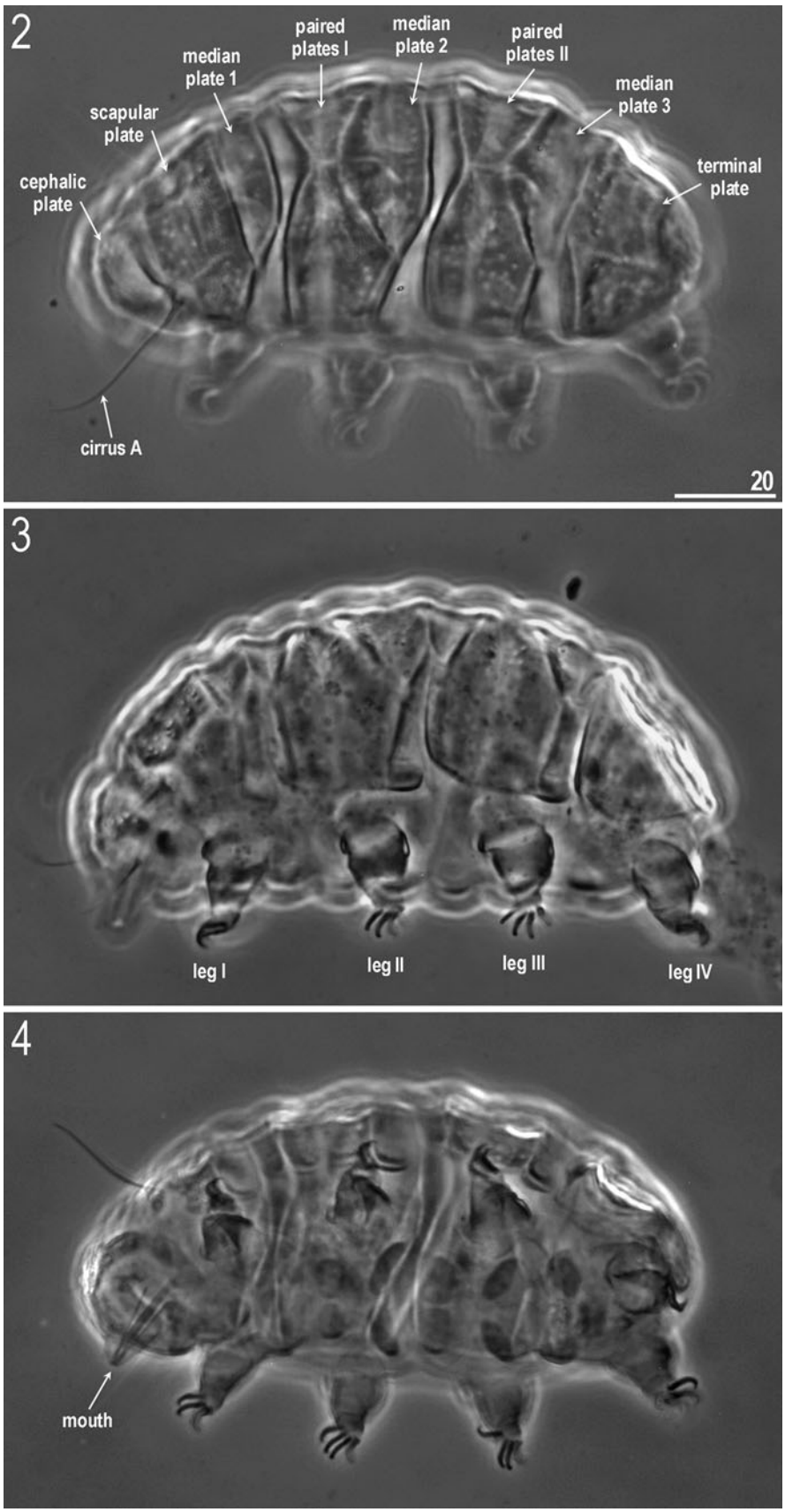
Type depositories Holotype (slide 14.2/20) and paratypes (slides: 14.2/4, 14.2/8, 14.2/9, 14.2/12, 14.2/13, 14.2/14, 14.2/16, 14.2/19) are deposited at the Department of Animal Taxonomy and Ecology, Institute of Environmental Biology, A. Mickiewicz University, Umultowska 89, 61-614 Poznań.

Differential Diagnosis Bryodelphax parvuspolaris sp. nov. has ventral plates and thus belongs to the *weglarskae* group (Kristensen et al. 2010); we therefore only compared other species of this group (see Fig. 8), using the ventral plates and other characters. The new species differs from:

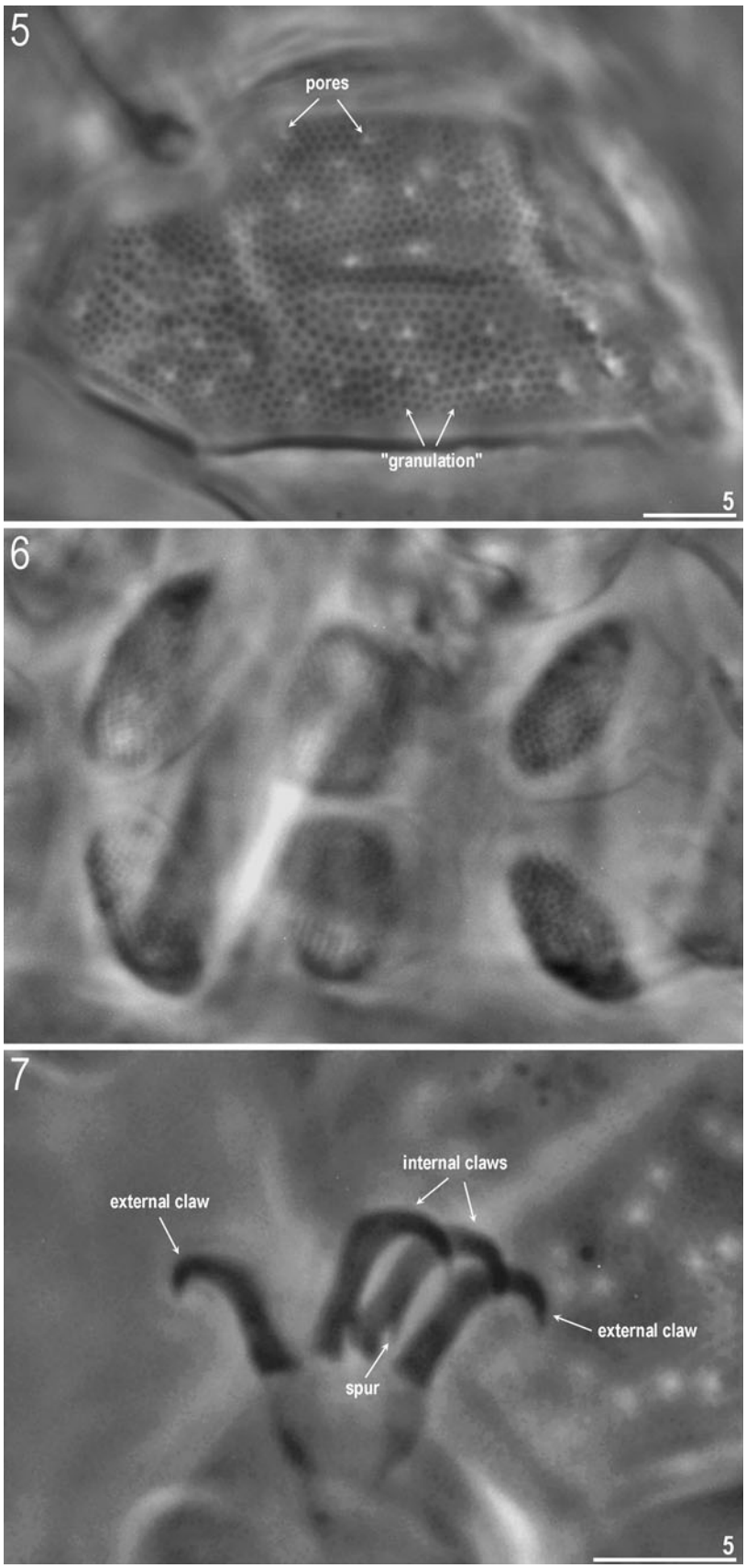
- *B. aaseae* Kristensen et al., 2010 by: a different ventral plate configuration (VIII:1-1-2-2-2-2-2-1 in the new species and X:2-1-4-4-2-4-2-1-2-1 in *B. aaseae*) and the presence of dentate collars on hind legs.
- *B. iohannis* Bertolani et al., 1995 by: a different ventral plate configuration (VIII:1-1-2-2-2-2-2-1 in the new species and X:2-1-1-5-2-4-2-2-2-1 in *B. iohannis*), a slightly smaller body size (87.4–125.0 in the new species and 113.9–179.5 in *B. iohannis*), and the presence of dentate collars on hind legs.
- *B. sinensis* Pilato, 1974 by: a different ventral plate configuration (VIII:1-1-2-2-2-2-2-1 in the new species and VII:2-2-2-2-2-2-1 in *B. sinensis*), slightly longer lateral appendages *A* (up to 37.4 in the new species and up to 27.0 in *B. sinensis*), and the presence of dentate collars hind legs.
- *B. weglarskae* Pilato, 1972 by: a different ventral plate configuration (VIII:1-1-2-2-2-2-2-1 in the new species and IX:2-1-5-2-4-2-2-2-1 in *B. weglarskae*) and by not bifurcated appendages.

Isohypsibius coulsoni sp. nov. (Figs. 9–13; Table 3)

Material examined Holotype (slide 34.2/29) and 80 paratypes (slides: 31.4/1, 31.4/3, 34.2/6, 34.2/7, 34.2/8, 34.2/9, 34.2/10, 34.2/11, 34.2/12, 34.2/13, 34.2/14, 34.2/15, 34.2/16,



Figs. 2–4 *Bryodelphax parvuspolaris* sp. nov. habitus. Fig. **2**. dorso-lateral view (holotype). Fig. **3**. lateral view (paratype). Fig. **4**. ventro-lateral view (holotype). *Scale* in μm, on 3–4 same as on 2



Figs. 5–7 *Bryodelphax parvuspolaris* sp. nov. Fig. **5**. sculpture on the scapular plate. Fig. **6**. ventral plates. Fig. **7**. claws III. *Scale* in μm, on 6 same as on 5

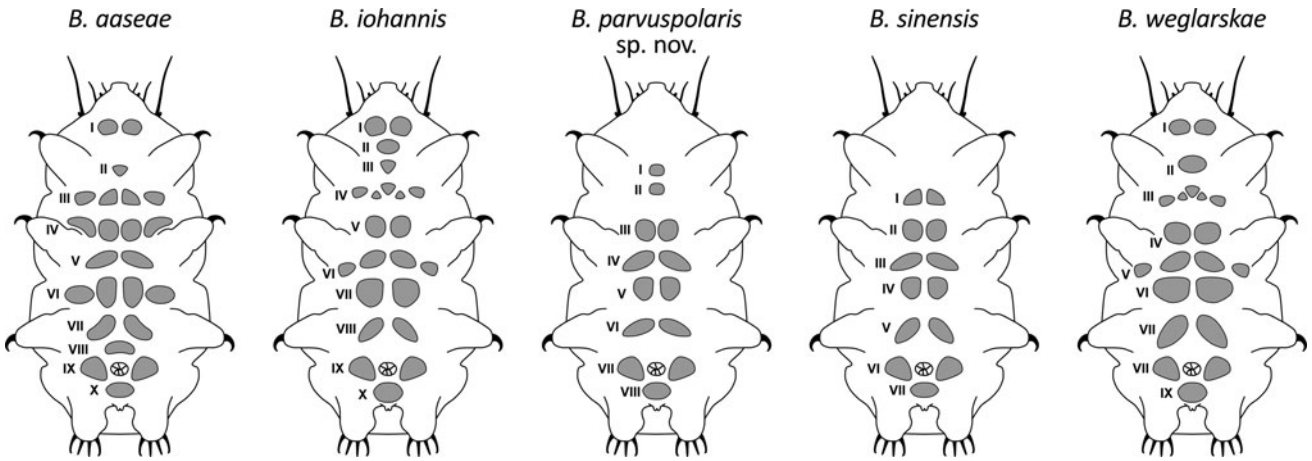


Fig. 8 Configurations of ventral plates in all known species of the *Bryodelphax weglarskae* group. *Roman numbers* indicate the rows in which the ventral plates are arranged

34.2/17, 34.2/18, 34.2/19, 34.2/20, 34.2/21, 34.2/22, 34.2/23, 34.2/24, 34.2/25, 34.2/26, 34.2/28, 34.2/29, 34.2/30, 34.2/31, 34.2/32, 34.2/33, 34.2/34).

Description (measurements in Table 3) Body transparent/white, eyes present (in live and mounted animals) in 83% of the examined specimens (Fig. 9). Dorso-lateral cuticle without gibbosities but covered with a reticular pattern (polygons diameter 0.9–3.2) (Fig. 10). Ventral cuticle smooth.

Bucco-pharyngeal apparatus of the *Isohypsibius* type, without ventral lamina (Fig. 11). Oral cavity armature absent or not visible under PCM. Pharyngeal bulb oval with three macroplacoids and a microplacoid. All macroplacoids without constrictions. Macroplacoid length sequence (smallest-medium-largest): 2-1-3.

Claws of the *Isohypsibius* type, similar in size and shape on all legs (Figs. 12, 13). All main branches with well-developed accessory points. Smooth lunules present on all claws, slightly larger on claws IV. Cuticular bars present under internal claws I–III.

Eggs white, smooth and deposited in exuvium (4–6 eggs per exuvium).

Etymology The new species is named in honour of Dr. Steve Coulson of the Department of Arctic Biology (UNIS) who helped us in collecting tardigrades from Spitsbergen.

Type locality Hornsund, the top of the Rotjesfjellet, mosses from rock, 437 m asl, 77°00′40″N, 15°22′20″E, 29.06.2010. coll. Łukasz Kaczmarek and Jerzy Smykla.

Additional localities Hornsund, south-east slope of the Rotjesfjellet, mosses and lichens from soil, 301 m asl, 77°00′31″N, 15°23′21″E, 29.06.2010. coll. Łukasz Kaczmarek and Jerzy Smykla.

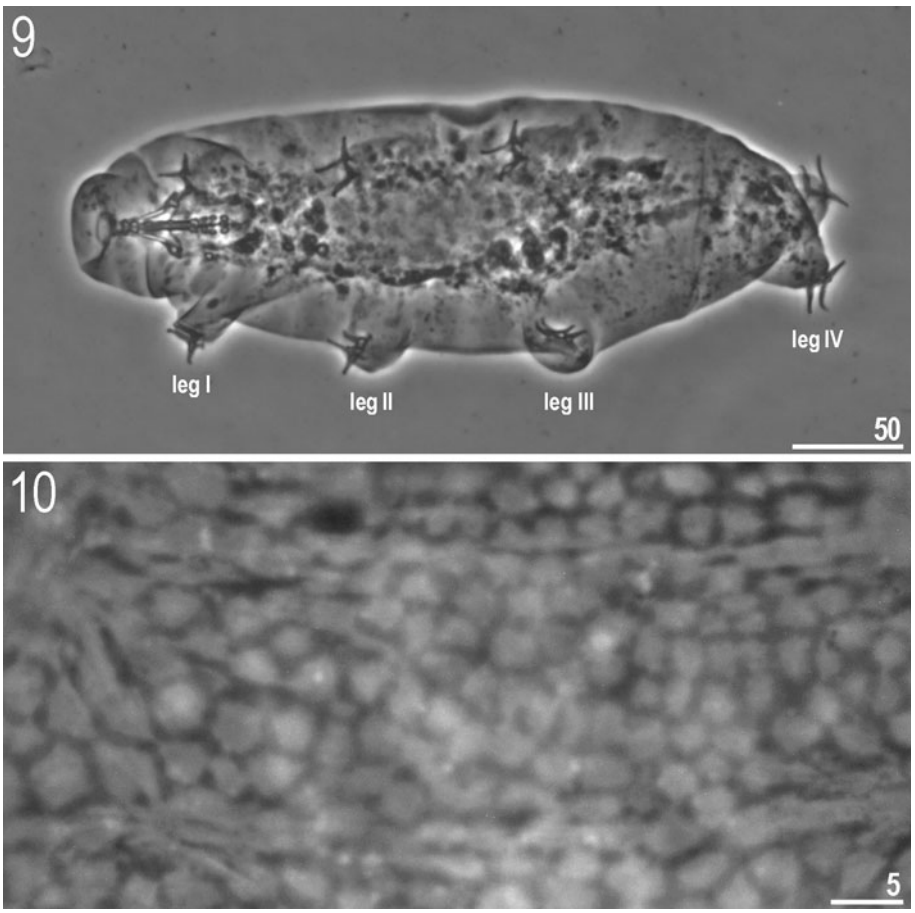
Type depositories Holotype (slide 34.2/29) and 80 paratypes (slides: 34.2/9, 34.2/12, 34.2/13, 34.2/14, 34.2/15, 34.2/16, 34.2/22, 34.2/23, 34.2/25, 34.2/26) are deposited at the Department of Animal Taxonomy and Ecology, Institute of Environmental Biology, A. Mickiewicz University, Umultowska 89, 61-614 Poznań.

Differential diagnosis Isohypsibius coulsoni sp. nov. differs from all other known *Isohypsibius* species with sculptured dorsal cuticle and three macroplacoids in the pharynx by a unique combination of the following characters: the presence of a microplacoid, the absence of cuticular gibbosities and the presence of accessory points on primary branches of all claws. The new species differs from the most similar:

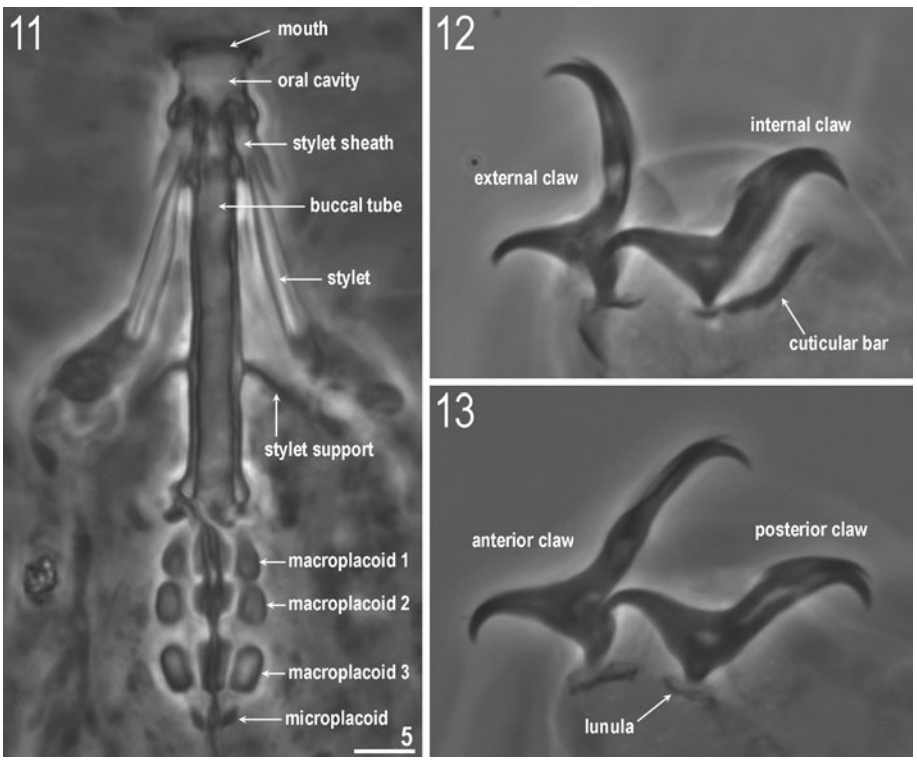
- *Isohypsibius glazovi* Biserov, 1999 (known only from Novaya Zemlya) by the absence of the cuticular gibbosities.
- *Isohypsibius ceciliae* Pilato and Binda, 1987 (which is also known from Spitsbergen) by: the absence of the reticular sculpture on the ventral side of the body, a distinctly smaller diameter of the reticular mesh on the dorsal cuticle (0.9-3.2 in the new species and about 5.0–6.0 in *I. ceciliae*) and the absence of the oral cavity armature.
- *Isohypsibius lineatus* (Mihelčič, 1969) (known only from Austria) by: a different shape and composition of the reticular sculpture (reticular mesh in the new species and irregular undulating lines in *I. lineatus*), different macroplacoid length sequence (2-1-3 in the new species and equal lengths in *I. lineatus*), the presence of accessory points on the primary branches of external claws and the presence of smooth lunules on all claws.

Other tardigrade species recorded from the Revdalen

In total, we found 25 species, including two new to science (described above) and two recorded from the Svalbard



Figs. 9–10 *Isohypsibius coulsoni* sp. nov. Fig. **9**. habitus (ventral view, holotype). Fig. **10**. sculpture on the dorsal cuticle (paratype). *Scale* in μm



Figs. 11–13 *Isohypsibius coulsoni* sp. nov. Fig. **11**. buccal apparatus (ventral view, holotype). Fig. **12**. claws III (paratype). Fig. **13**. claws IV (paratype). *Scale* in μm, on 12–13 same as on 11

Table 3 Measurements and *pt* values of selected morphological structures of eleven specimens (including the holotype) from the type population of *Isohypsibius coulsoni* sp. nov.

Character	N	Range		Mean		SD		Holotype	
		μm	*pt*	μm	*pt*	μm	*pt*	μm	*pt*
Body length	11	163–338	*677–1133*	278	*893*	61	*140*	336	*1,011*
Bucco-pharyngeal tube									
Buccal tube length	11	24.0–35.1	–	30.9	–	3.5	–	33.2	–
Stylet support insertion point	11	15.8–22.9	*63.4–67.0*	20.1	*65.2*	2.2	*1.0*	21.6	*65.1*
Buccal tube external width	11	2.8–4.2	*10.9–13.1*	3.7	*11.9*	0.5	*0.7*	4.2	*12.7*
Buccal tube internal width	11	1.6–2.6	*6.2–7.8*	2.1	*6.8*	0.3	*0.4*	2.6	*7.8*
Placoid lengths									
Macroplacoid 1	11	2.7–3.7	*9.1–12.5*	3.4	*11.1*	0.3	*0.9*	3.4	*10.2*
Macroplacoid 2	11	2.0–3.3	*8.0–10.1*	2.8	*9.2*	0.4	*0.7*	3.3	*9.9*
Macroplacoid 3	11	2.6–4.7	*10.8–14.4*	3.9	*12.7*	0.6	*1.1*	3.9	*11.7*
Microplacoid	10	1.0–2.2	*3.6–6.3*	1.6	*5.0*	0.4	*1.0*	2.0	*6.0*
Macroplacoid row	11	9.6–14.7	*40.0–43.6*	12.8	*41.6*	1.6	*1.2*	13.4	*40.4*
Placoid row	10	11.7–17.8	*46.8–52.0*	15.2	*49.2*	2.0	*1.8*	15.9	*47.9*
Claw I lengths									
External base	4	4.7–5.9	*15.8–19.8*	5.4	*17.9*	0.5	*2.1*	?	*?*
External primary branch	5	7.0–12.5	*27.3–36.5*	10.2	*32.7*	2.3	*4.2*	?	*?*
External secondary branch	5	4.8–8.5	*19.4–24.9*	6.8	*21.8*	1.4	*2.2*	?	*?*
Internal base	5	3.7–6.0	*15.1–18.2*	5.0	*16.4*	0.9	*1.4*	?	*?*
Internal primary branch	6	6.5–11.3	*23.2–32.2*	8.2	*26.6*	1.7	*3.1*	?	*?*
Internal secondary branch	6	3.5–6.7	*14.1–21.5*	5.6	*17.9*	1.3	*3.0*	?	*?*
Claw II lengths									
External base	6	4.9–7.0	*15.8–21.1*	5.8	*18.4*	0.8	*2.2*	7.0	*21.1*
External primary branch	6	9.3–14.2	*32.4–42.8*	12.1	*38.1*	2.2	*3.5*	14.2	*42.8*
External secondary branch	6	4.3–8.6	*16.8–25.3*	7.4	*23.1*	1.6	*3.3*	8.4	*25.3*
Internal base	6	4.0–6.1	*14.9–18.4*	5.0	*16.1*	0.8	*1.2*	6.1	*18.4*
Internal primary branch	7	6.8–12.2	*22.5–34.8*	8.9	*28.6*	2.1	*4.9*	11.1	*33.4*
Internal secondary branch	7	3.8–7.7	*14.8–23.5*	6.1	*19.5*	1.3	*3.4*	7.7	*23.2*
Claw III lengths									
External base	5	6.0–7.3	*18.5–22.5*	6.7	*20.3*	0.5	*1.5*	6.7	*20.2*
External primary branch	5	12.5–14.9	*40.9–42.6*	13.9	*42.1*	0.9	*0.7*	14.1	*42.5*
External secondary branch	5	7.0–8.8	*20.5–26.5*	8.1	*24.5*	0.7	*2.4*	8.8	*26.5*
Internal base	4	4.2–6.6	*16.4–18.8*	5.4	*18.1*	1.2	*1.1*	6.1	*18.4*
Internal primary branch	5	5.9–11.7	*24.6–35.2*	8.6	*28.5*	2.5	*4.3*	11.7	*35.2*
Internal secondary branch	5	4.2–7.7	*15.4–23.2*	5.6	*18.6*	1.4	*2.9*	7.7	*23.2*
Claw IV lengths									
Anterior base	5	4.3–6.7	*16.7–22.5*	5.7	*19.2*	1.0	*2.5*	?	*?*
Anterior primary branch	6	10.5–16.0	*41.0–52.3*	14.4	*47.7*	2.0	*3.8*	?	*?*
Anterior secondary branch	6	5.4–8.9	*21.1–29.5*	8.0	*26.5*	1.3	*3.1*	?	*?*
Posterior base	4	4.6–6.0	*15.0–19.1*	5.4	*16.7*	0.6	*2.0*	?	*?*
Posterior primary branch	5	9.9–12.1	*32.4–36.6*	11.0	*34.2*	0.8	*1.8*	?	*?*
Posterior secondary branch	4	6.8–8.1	*20.5–27.2*	7.4	*23.0*	0.5	*2.9*	?	*?*

N number of specimens or structures measured, *Range* the smallest and the largest structure found among all specimens measured, *SD* standard deviation, *pt* ratio of the length of a given structure to the length of the buccal tube, expressed as a percentage, *?* structure oriented unsuitably for measurement

Table 4 A list of all species found in the present study with information on previous records from Svalbard and zoogeographic and taxonomic remarks

Species	Previous records in Svalbard	Current study (localities: number of specimens + eggs found)	Remarks
Bryodelphax parvuspolaris sp. nov.	–	III: 9	New species found in the present study, so far known only from Svalbard
Calohypsibius ornatus (Richters, 1900)	Smeerenburg on Amsterdamøya (Richters 1903); Hornsund (Węglarska 1965); Atomfjella (Dastych 1985)	V: 1	Cosmopolitan (McInnes 1994)
Diphascon (Adropion) prorsirostre Thulin, 1928	–	III: 3, XIII: 1, XVII: 2, XXIX: 7	The *Diphascon* (*Adropion*) *prorsirostre* complex is cosmopolitan (McInnes 1994); however, the majority of these records need be verified. This is the first official report of this species from Svalbard, as it was mistakenly listed from the Svalbard Archipelago by Coulson (2011), who possibly misread Maucci (1996)
Diphascon (*Adropion*) *scoticum scoticum* Murray, 1905	Prins Karls Forland, Recherchefjorden (Murray 1907); Van Mijenfjorden, Bellsund (Richters 1911); Torbjørnsenfjellet region in Hornsund (Węglarska 1965); Bünsow Land, Albert I Land, Atomfjella, Hornsund (Dastych 1985); Semenovfjella (De Smet et al. 1987); Barentsøya (Van Rompu and De Smet 1991); Isbjörnhamna (Janiec 1996); Vesletinden-Dotten (Łagisz 1999)	III: 1	The *Diphascon* (*Adropion*) *scoticum scoticum* complex is cosmopolitan (McInnes 1994); however, the majority of these records need be verified
Diphascon (Diphascon) pingue pingue (Marcus, 1936)	Oscar II Land, Albert I Land, Atomfjella, Hornsund (Dastych 1985); Barentsøya (Van Rompu and De Smet 1991)	XXIX: 1	The *pingue* group of species is cosmopolitan (McInnes 1994); however, the majority of these records need be verified (Fontoura and Pilato 2007)
Diphascon (Diphascon) recamieri Richters, 1911	Adventfjorden (Richters 1911); Bünsow Land, Albert I Land, Ny-Friesland, Atomfjella, Hornsund (Dastych 1985); Hyrnebeen (De Smet and Van Rompu 1994); Isbjörnhamna (Janiec 1996); Vesletinden-Dotten (Łagisz 1999)	IV: 2, VIII: 2, XII: 2, XXI: 1, XXII: 1, XXIV: 3, XXVI: 2, XXVIII: 2	Holarctic species, recorded from sparse localities in Europe, Asia and North America (McInnes 1994)
Echiniscus merokensis merokensis Richters, 1904	Smeerenburg on Amsterdamøya (Richters 1904); Albert I Land, Haakon VII Land, Andrée Land, Ny-Friesland, Atomfjella, Hornsund (Dastych 1985)	V: 2, XXVIII: 1	Palaearctic (McInnes 1994)
Echiniscus quadrispinosus quadrispinosus Richters, 1902	An unidentified locality on Spitsbergen (Marcus 1928)	V: 1	Cosmopolitan (McInnes 1994)
Echiniscus testudo (Doyère, 1840)	An unidentified locality on Spitsbergen (Richters 1904); Atomfjella (Dastych 1985)	XV: 2, XXIX: 2	Holarctic (McInnes 1994)

Table 4 continued

Species	Previous records in Svalbard	Current study (localities: number of specimens + eggs found)	Remarks
Echiniscus wendti Richters, 1903	Smeerenburg on Amsterdamøya (Richters 1903); Hornsund (edge of the Hansbreen) (Węglarska 1965); Wedel Jarlsberg Land, Oscar II Land, Albert I Land, Andrée Land, Ny-Friesland, Atomfjella, Hornsund (Dastych 1985); Isbjörnhamna (Janiec 1996); Tsjebysjovfjellet (Łagisz 1999)	V: 35, IX: 2	Cosmopolitan (McInnes 1994)
Hebesuncus conjungens (Thulin, 1911)	Atomfjella (Dastych 1985); Barentsøya (Van Rompu and De Smet 1991)	V: 4, VI: 1	Cosmopolitan species, recorded from several localities throughout the world (McInnes 1994)
Hypsibius dujardini (Doyère, 1840)	Torbjørnsenfjellet and Ariekammen in Hornsund (Węglarska 1965); Bünsow Land, Ny-Friesland, Atomfjella, Hornsund (Dastych 1985); Smeerenburg (De Smet et al. 1987); Russebukta (De Smet et al. 1988); Bjørnøya (Van Rompu and De Smet 1988); Barentsøya (Van Rompu and De Smet 1991); Isbjörnhamna (Janiec 1996); Kvitgubben (Łagisz 1999)	II: 2, IV: 59, X: 1	This species belongs to the dujardini group of species, which is cosmopolitan (McInnes 1994)
Hypsibius microps Thulin, 1928	Skrål Pynten in the Hornsund area (Maucci 1996)	II: 1, III: 3, V: 2, VI: 4, XIX: 1	This species belongs to the *convergens* group of species, which is cosmopolitan (McInnes 1994); however, the majority of these records need to verified (Kaczmarek and Michalczyk 2009)
Hypsibius pallidus Thulin, 1911	Rotjesfjellet and Ariekammen in Hornsund (Węglarska 1965); Atomfjella, Hornsund (Dastych 1985); Isbjörnhamna (Janiec 1996); Vesletinden-Dotten (Łagisz 1999)	XXVI: 1	Cosmopolitan (McInnes 1994) (but see also comments to *H. microps*)
Isohypsibius coulsoni sp. nov.	–	XXV: 7, XXVIII: 74	New species found in the present study, so far known only from Svalbard
Macrobiotus crenulatus Richters, 1904	Smeerenburg on Amsterdamøya (Richters 1903); Prins Karls Forland (Murray 1907)	X: 1 + 1, XIII: 5 + 1, XV: 3, XX: 2	Holarctic (McInnes 1994)
Macrobiotus harmsworthi harmsworthi Murray, 1907	Prins Karls Forland (Murray 1907); Adventfjorden, Van Mijenfjorden, Bellsund (Richters 1911); Albert I Land, Ny-Friesland, Atomfjella, Hornsund (Dastych 1985); Dotten, Tsjebysjovfjellet, Bastionbreen (Łagisz 1999)	III: 0 + 1, VIII: 1 + 1, VII: 4 + 1, XII: 0 + 3, XIII: 1 + 1, XVII: 0 + 1, XVIII: 0 + 1, XIX: 1 + 5, XIV: 4 + 5, XXIX: 2 + 1	The *harmsworthi* group of species is cosmopolitan (McInnes 1994)
Macrobiotus harmsworthi obscurus Dastych, 1985	Bünsow Land, Albert I Land, Andrée Land, Atomfjella, Hornsund (Dastych 1985)	VI: 4 + 2, IX: 4 + 9, XI: 9 + 1	Known only from Spitsbergen and Russia (Ural Mts.) (McInnes 1994)

Table 4 continued

Species	Previous records in Svalbard	Current study (localities: number of specimens + eggs found)	Remarks
Macrobiotus hufelandi hufelandi Schultze, 1834	Adventfjorden, Isfjorden (Scourfield 1897); Prins Karls Forland, Recherchefjorden (Murray 1907); Van Mijenfjorden, Bellsund (Richters 1911); Torbjørnsenfjellet, Rotjesfjellet and Ariekammen in Hornsund (Węglarska 1965); Bünsow Land and Atomfjella (Dastych 1985); Bjørnøya (Van Rompu and De Smet 1988); Krykkjestupet, Vesletinden-Dotten, Vesletinden (Łagisz 1999)	XIX: 5 + 4, XXI: 2 + 2, XXIV: 4 + 4, XXVI: 14 + 3	The *hufelandi* group of species is cosmopolitan (McInnes 1994); however, the majority of these records need to be verified (Bertolani and Rebecchi 1993)
Macrobiotus islandicus islandicus Richters, 1904	Prins Karls Forland, Recherchefjorden (Murray 1907); Hornsund (Węglarska 1965); Bünsow Land, Albert I Land, Andrée Land, Ny-Friesland, Atomfjella (Dastych 1985); Vesletinden-Dotten, Kvitgubben (Łagisz 1999)	V: 17 + 9, VII: 5 + 2, XIX: 11 + 9, XI: 4 + 3, XVII: 0 + 1, XXI: 21 and 7	Holarctic (McInnes 1994)
Milnesium asiaticum Tumanov, 2006	–	IX: 1	Previously known only from the type locality in Kyrgyzstan (Tumanov 2006)
Milnesium eurystomum Maucci, 1991	–	V: 1	Known only from Greenland and Spitsbergen (Michalczyk et al. 2012)
Platicrista angustata (Murray, 1905)	Prins Karls Forland, Recherchefjorden (Murray 1907); Bünsow Land, Ny-Friesland, Atomfjella, Hornsund (Dastych 1985)	XXI: 2, XXVI: 4	Holarctic species, recorded from many localities in Europe, Asia and North America (McInnes 1994)
Pseudechiniscus suillus (Ehrenberg, 1853)	Prins Karls Forland (Murray 1907); Torbjørnsenfjellet, Rotjesfjellet and Ariekammen in Hornsund (Węglarska 1965); Ny-Friesland, Atomfjella (Dastych 1985); Barentsøya (Van Rompu and De Smet 1991)	III: 4, XVI: 2	The *suillus* group of species is cosmopolitan, but distribution of nominal species is unknown (McInnes 1994)
Testechiniscus spitsbergensis (Scourfield, 1897)	Adventfjorden (Scourfield 1897); Bünsow Land, Albert I Land, Andrée Land, Ny-Friesland, Atomfjella, Hornsund (Dastych 1985); Barentsøya (Van Rompu and De Smet 1991); Krykkjestupet, Dotten, Vesletinden-Dotten, Vesletinden, Kneikfjellet, Kvitknotten, Sjdanovfjellet, Kvitgubben (Łagisz 1999)	V: 4, XIV: 1, XVIII: 1, XX: 7, XXI: 29, XXII: 1	Holarctic (McInnes 1994)

Archipelago for the first time (*Milnesium asiaticum* Tumanov, 2006 and *Diphascon* (*Adropion*) *prorsirostre* Thulin, 1928). All species with notes on their previous records from the Svalbard Archipelago and zoogeographic and taxonomic remarks are listed in Table 4.

Acknowledgments The material for this work was collected during the XXXIII Polar Expedition of the Polish Academy of Sciences to Svalbard in 2010. The authors would like to thank the whole team of the Polish Research Station "Hornsund" for their hospitality and logistic support. Thanks are also due to the Department of the Polar Research Institute of Geophysics of the Polish Academy of Sciences for providing logistical support during the fieldwork. We are also grateful to Reinhardt M. Kristensen, Sandra J. McInnes, and the third (anonymous) reviewer for their valuable improvements to our manuscript. The research was also partly supported by the Polish Ministry of Science and Higher Education within the programme 'Supporting International Mobility of Scientists' edition III, project no. 2 to JS and the National Science Centre grant no. NN304014939 to ŁK, ŁM & JS.

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