

## Four new *Isohypsibius* species from Russian fresh waters (Tardigrada, Hypsibiidae)

by Denis V. TUMANOV

### Abstract

Four new Tardigrada species, attributed to the «*Isohypsibius granulifer* group», were found in fresh waters of North-Western Russia. *Isohypsibius pushkini* and *Is. kotovae* are most similar to *Is. tubericulatus*, while *Isohypsibius ladogensis* and *Is. baldioides* are closely related to *Is. monoicus* and *Is. baldii*, respectively.

**Key words:** Tardigrada, *Isohypsibius*, fresh water, Russia, systematics.

### Introduction

The Tardigrada fauna of European fresh waters is poorly investigated in comparison to our knowledge of semi-terrestrial tardigrades of the same region. Within the genus *Isohypsibius* THULIN, 1928, the complex of morphologically similar species, closely related to the species *Isohypsibius granulifer* THULIN, 1928, represents one of the most common components of the freshwater tardigrade community.

A new species group «*granulifer*» is established in the present paper for the sculptured *Isohypsibius*-species with three macroplacoids and without any microplacoids or septula. The following recognized species are included in this group: *Is. asper* (MURRAY, 1906), *Is. baicalensis* RAMAZZOTTI, 1966, *Is. baldii* RAMAZZOTTI, 1945, *Is. brulloi* PILATO & PENNISI, 1976, *Is. campbellensis* PILATO, 1996, *Is. granulifer*, *Is. irregibilis* BISEROV, 1992, *Is. kenodontis* KENDALL-FITE & NELSON, 1996, *Is. laevis* MCINNES, 1995, *Is. marii* BERTOLANI, 1981, *Is. monoicus* BERTOLANI, 1981, *Is. palmai* PILATO, 1996, *Is. rugosus* GUIDI & GRABOWSKI, 1996, *Is. tubericulatus* PILATO & CATANZARO, 1989 and *Is. wilsoni* (HORNING, SCHUSTER & GREGARICK, 1978)

In the present paper four new *Isohypsibius* species, belonging to the newly recognized group, are described. They were discovered by the author, during the investigation of the freshwater tardigrade fauna of North-West Russia in 1996-1999, together with two known species of this group: *Is. granulifer* and *Is. marii*.

### Material and methods

Various freshwater sediments were collected from a number of water bodies. All samples have been washed through a system of sieves. The content of the fine sieve was screened under a dissection microscope. One part of the Tardigrada material was fixed with acetic acid and then mounted in Faure fluid, the rest was postfixed with formaldehyde and then mounted in Faure fluid. Preparations were examined using a phase-contrast microscope.

The following abbreviations are used for dimensional characters: btl - buccal tube length; ssi - distance from cephalic end of buccal tube to stilet supports; btd - inner buccal tube diameter; prl - length of the row of macroplacoids; fpl, spl, tpl - length of 1st, 2nd and 3rd macroplacoids; U4e - external claws height of the 4th pair of legs; U4i - internal claws height of the 4th pair of legs. Index Pt (percent length of a structure compared with the buccal tube length) (PILATO, 1981) is also used in the present paper. All measurements are given in mm.

Holotypes and paratypes of the new species are deposited in the author's collection at the Zoological Institute Russian Academy of Sciences, St. Petersburg, Russia.

#### 1. *Isohypsibius ladogensis* sp. n. (Tab. 1, Fig. 1)

HOLOTYPE. Slide number 146(8) (sex indet).

TYPE LOCALITY. Ladoga Lake, Malaya Nikonovskaya bay of Valaam Island.

PARATYPES. Slide numbers 146(3), 146(6), 146(7), 146(9), 146(12), 149(2), 197(1) from the same location and from inner pools of the Valaam Island.

ADDITIONAL MATERIAL. 6 adult animals from the same locations.

ETYMOLOGY. This species is named after the type locality, Ladoga Lake.

Table 1. Measurements of *Isohypsibius ladogensis* (in  $\mu\text{m}$ ) (N = 11).

| Measurements | Holotype | Mean (Range)     | Standard deviation |
|--------------|----------|------------------|--------------------|
| Btl          | 31.5     | 35.3 (31-41)     | 2.8                |
| Ssi          | 22.0     | 24.3 (21.5-28.9) | 2.1                |
| Ptss (in %)  | 69.8     | 68.8 (66.2-70.8) | 1.4                |
| Btd          | 2.3      | 2.6 (1.5-3.3)    | 0.5                |
| Prl          | 12.0     | 13.7 (12-17)     | 1.5                |
| Fpl          | 3.5      | 3.8 (3.1-5)      | 0.5                |
| Spl          | 3.0      | 3.9 (3-5)        | 0.6                |
| Tpl          | 4.5      | 5.0 (4-7)        | 0.8                |
| Ptprl (in %) | 38.1     | 38.7 (35.3-41.5) | 2.0                |
| U4e          | 22.1     | 24.5 (18.9-31.1) | 4.1                |
| U4I          | 16.2     | 18.5 (15-23)     | 2.6                |
| PtU4e (in %) | 67.9     | 69.6 (57.7-86.4) | 9.0                |

#### DESCRIPTION

Length of adult animals from 250 to 369 (holotype length 315). Body white. Eye spots present in most specimens. Cuticle sculptured with indistinct granules fused laterally. These granules form a reticulate (rarely rugose) pattern. In some specimens, sculpture scarcely visible.

Buccal armature with 3-5 well developed points ventrally, similar to those described by BERTOLANI (1988) in *Is. monoicus* and *Is. baicalensis*. Pharyngeal bulb nearly spherical and containing apophyses and three macroplacoids. Macroplacoids very broad, the first and second ones subequal in length, the third distinctly longer (for dimensions see Table 1).

Legs with claws of moderate length, typical of the genus *Isohypsibius*. Claws of legs IV slightly larger than claws of legs I-III. Claws of legs I-III without accessory points (in some specimens, almost invisible accessory points present). Lunules present at least at bases of external claws of legs I-III. Near bases of internal claws of legs I-III thin cuticular bars present (scarcely visible in some specimens). Claws of legs IV with well developed accessory points and little lunules.

Smooth eggs laid within exuvia.

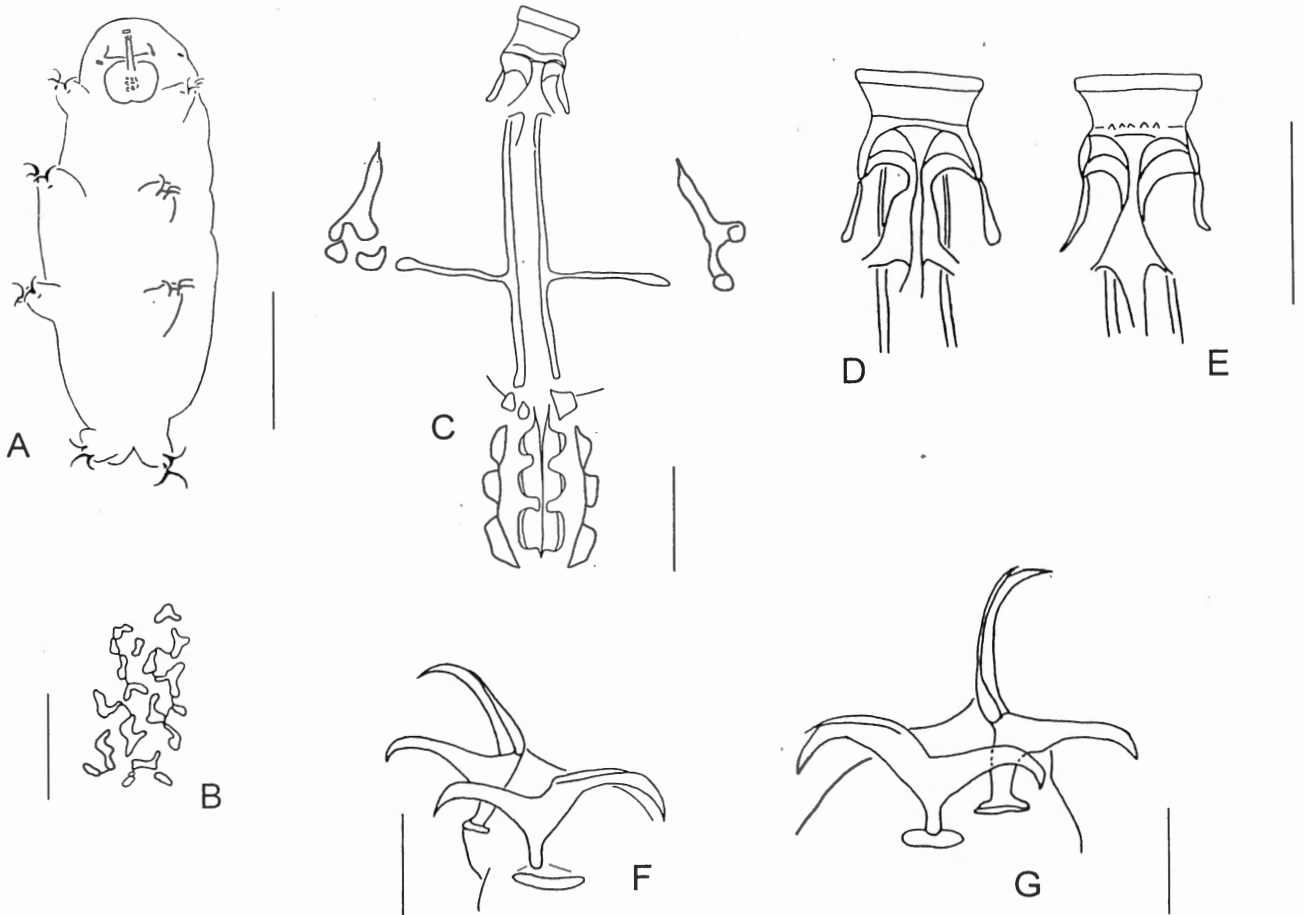


Fig. 1. *Isohypsibius ladogensis* sp. nov., A. Habitus. B. Dorsal sculpture. C. Bucco-pharyngeal apparatus. D. Buccal armature, dorsal view. E. Buccal armature, ventral view. F. Claws of leg II. G. Claws of leg IV. Scale bars: Fig. A 100  $\mu\text{m}$ , Figs C-G 10  $\mu\text{m}$ .

## REMARKS

*Isohypsibius ladogensis* sp. nov. is mostly similar to *Is. baicalensis* and *Is. monoicus* by the presence of wide macroplacoids and points in the buccal cavity. It is distinguished from these species by the length of the third macroplacoid, which in the new species is distinctly longer than the first and the second macroplacoids, while in *Is. baicalensis* and *Is. monoicus* all macroplacoids are subequal in length. Furthermore, these species clearly differ from *Is. ladogensis* by the absence of cuticular bars near the claw bases of the legs I-III and lunules. Details of the cuticular sculpture could provide additional information for distinguishing of these species. *Is. campbellensis* and *Is. ladogensis* have a similar type of bucco-pharyngeal apparatus, but the former species differs from *Is. ladogensis* by the absence of the cuticular bars near the claw bases of the legs I-III and by the reticular sculpture of cuticle.

2. *Isohypsibius pushkini* sp. n.

(Tab. 2, Fig. 2)

HOLOTYPE. Slide number 192(2) (sex indet).

TYPE LOCALITY. A little ditch in the «Otdelnyi» Park, near

Table 2. Measurements of *Isohypsibius pushkini* (in  $\mu\text{m}$ ) (N = 21).

| Measurements | Holotype | Mean (Range)     | Standard deviation |
|--------------|----------|------------------|--------------------|
| Btl          | 36.1     | 36.3 (33.4-38)   | 1.0                |
| Ssi          | 23.6     | 24.3 (22.5-25.4) | 0.7                |
| Ptss (in %)  | 65.4     | 67.1 (64.9-69.9) | 1.3                |
| Btd          | 2.9      | 2.5 (2.1-3)      | 0.3                |
| Prl          | 15.0     | 15.3 (13.2-16.4) | 0.8                |
| Fpl          | 4.4      | 4.3 (3.9-4.8)    | 0.3                |
| Spl          | 4.1      | 4.1 (3.8-4.5)    | 0.2                |
| Tpl          | 5.5      | 5.2 (4.6-6)      | 0.3                |
| Ptprl (in %) | 41.6     | 42.3 (39.3-44.6) | 1.5                |
| U4e          | 30.5     | 30.9 (27.5-35)   | 2.1                |
| U4l          | 23.0     | 21.8 (20-25)     | 1.3                |
| PtU4e (in %) | 84.5     | 85.2 (76.4-96.9) | 5.9                |

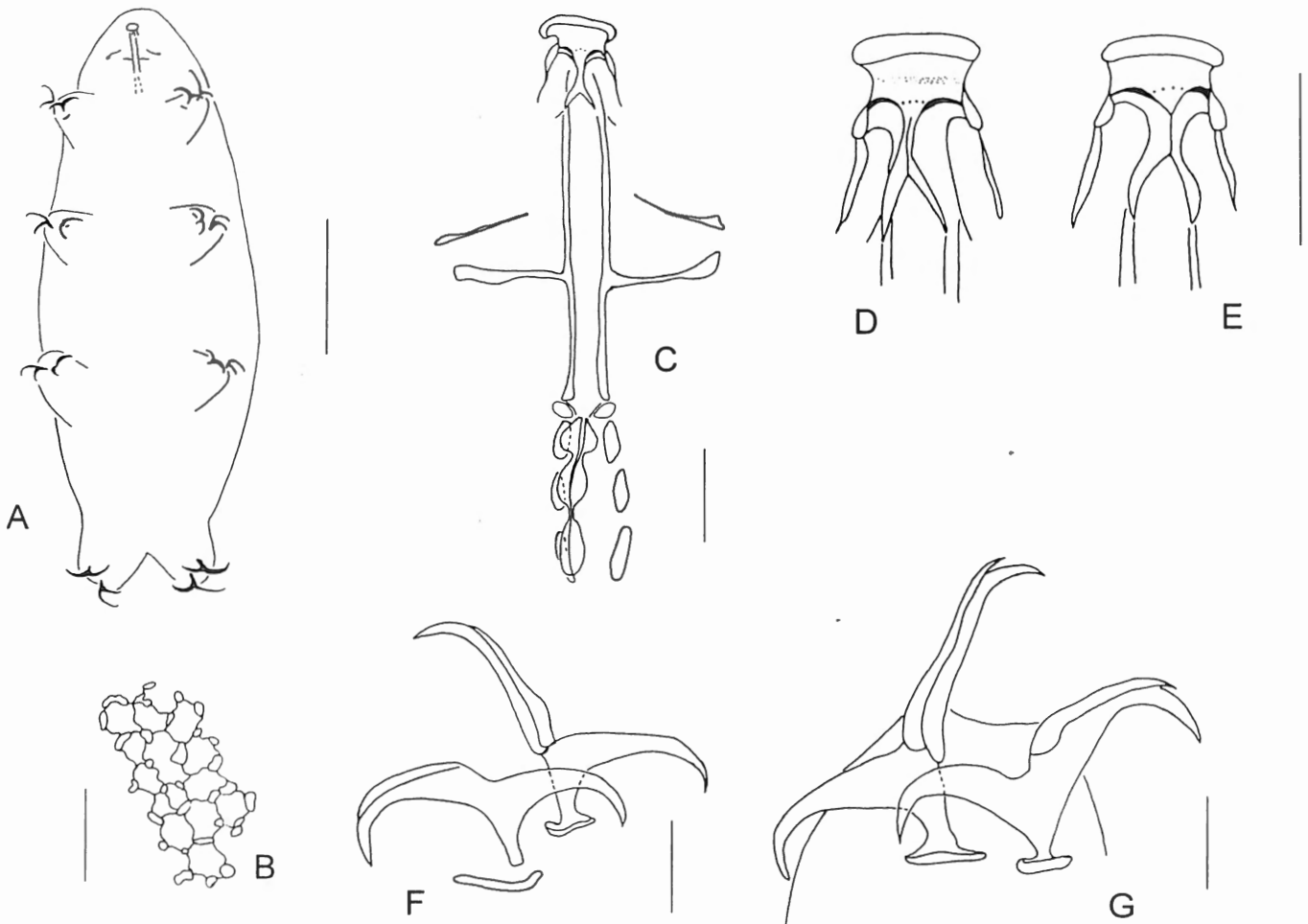


Fig. 2. *Isohypsibius pushkini* sp. nov., A. Habitus. B. Dorsal sculpture. C. Bucco-pharyngeal apparatus. D. Buccal armature, dorsal view. E. Buccal armature, ventral view. F. Claws of leg I. G. Claws of leg IV. Scale bars: Fig. A 100  $\mu\text{m}$ , Figs C-G 10  $\mu\text{m}$ .

Pushkin City, (St. Petersburg Prov.).

PARATYPES. Slide numbers 124(3), 124(4), 125(1), 125(2), 125(11), 125(14), 125(19), 192(13), 193(4), 193(5), 194(1), 194(3) from the same location and from the little pools in the parks of Pushkin and Pavlovsk.

ADDITIONAL MATERIAL. 7 adult animals from the same locations.

ETYMOLOGY. This species is named after the type locality, Pushkin City.

#### DESCRIPTION

Length of adult animals 360-463.5 (holotype length 405). Body white. Eye spots present in most specimens. Cuticle sculpture very similar to the one described by PILATO & CATANZARO (1989) in *Is. tubericulatus*. It consists of the granules, connected with thin, winding ridges, forming a reticulate pattern. Usually, the width of the ridges is less than the diameter of the granules, rarely they are subequal. In younger specimens the sculpture can be weakly developed. Buccal armature with latero-dorsal and latero-ventral ridges, medially, on the dorsal and ventral sides of buccal cavity, rows of rounded teeth present (in some specimens indistinctly separated, in younger animals invisible). In large specimens a relatively wide band of minute points is present, anterior to the ridges. Pharyngeal bulb oval to spherical and containing apophyses and three thin macroplacoids. First macroplacoid usually slightly longer than second, the third being the longest (for dimensions see Table 2).

Legs with claws of moderate length, typical of the genus *Isohypsibius*. Claws of legs IV slightly larger than claws of legs I-III. Claws of legs I-III without accessory points. Lunules usually present at bases of external claws of legs I-III. Near bases of internal claws of legs I-III, thin cuticular bars present (scarcely visible in some specimens). Claws of the legs IV with well developed accessory points and little lunules.

Smooth eggs laid within exuvia.

#### REMARKS

*Isohypsibius pushkini* sp. nov. is mostly similar to *Is. tubericulatus* by the type of cuticular sculpture. It can be distinguished from this species by the length of the body (315-342 to 160-202 in *Is. tubericulatus*), the absence of a constriction in the posterior part of the third macroplacoid, the more robust claws and by the presence of cuticular bars on the legs I-III.

### 3. *Isohypsibius kotovae* sp. n. (Tab. 3, Fig. 3)

HOLOTYPE. Slide number 160(6) (sex indet).

TYPE LOCALITY. Little stream, tributary of the Kemka river (Luga Distr., St. Petersburg Prov.).

PARATYPES. Slide numbers 160(1) and 160(3) from the same location.

ETYMOLOGY. The species is dedicated to Mrs. J.A. KOTOVA (St. Petersburg), who kindly offered me the material for investigation.

Table 3. Measurements of *Isohypsibius kotovae* (in  $\mu\text{m}$ ) (N = 3).

| Measurements | Holotype | Mean (Range)     | Standard deviation |
|--------------|----------|------------------|--------------------|
| Btl          | 29.1     | 27.7 (25-29.1)   | 2.3                |
| Ssi          | 20.0     | 18.9 (17.2-20)   | 1.5                |
| Ptss (in %)  | 68.7     | 68.3 (67.2-68.8) | 0.9                |
| Btd          | 2.2      | 2.4 (2-3)        | 0.5                |
| Prl          | 12.2     | 12.3 (11.2-13.4) | 1.1                |
| Fpl          | 2.6      | 2.7 (2.5-3)      | 0.3                |
| Spl          | 2.9      | 3.2 (2.9-3.6)    | 0.4                |
| Tpl          | 4.3      | 4.6 (4-5.6)      | 0.9                |
| Ptprl (in %) | 41.9     | 44.3 (41.9-46.2) | 2.2                |
| U4e          | 19.2     | 18.8 (16.3-21)   | 2.4                |
| U4l          | 13.5     | 13.4 (12.5-14.2) | 0.9                |
| PtU4e (in %) | 66.0     | 67.9 (65.2-72.4) | 4.0                |

#### DESCRIPTION

Length of adult animals 216-297 (holotype length 243). Body white. Eye spots absent. Cuticular sculpture (dorsal and lateral) consists of very delicate reticulation (diameter of polygonal meshes usually less than 1 mm).

Buccal armature with thin latero-dorsal and latero-ventral ridges only. Pharyngeal bulb oval and containing apophyses and three thin macroplacoids. First macroplacoid usually slightly shorter than second, the third being the longest (for dimensions see Table 3). Third macroplacoid with distinct constriction on the posterior end.

Legs with claws, typical of the genus *Isohypsibius*. Claws of legs IV slightly larger than claws of legs I-III. Claws of legs I-III with minute accessory points. Claws of legs I-III with weakly developed lunules, usually better visible on external claws. Without cuticular bars on legs I-III. Claws of legs IV with developed accessory points and little lunules.

Eggs unknown.

#### REMARKS

*Isohypsibius kotovae* sp. nov. is mostly similar to *Is. tubericulatus* by the type of bucco-pharyngeal apparatus (especially by the constricted third macroplacoid). It is easily distinguished from this species by the absence of tubercles in the cuticular sculpture and by the presence of accessory points on the claws. Furthermore, the claws themselves are markedly more massive than in *Is. tubericulatus*. This species is similar to some *Isohypsibius*-species by the type of cuticular sculpture. It differs from *Is. reticulatus* PILATO, 1973 by the presence of three macroplacoids and by the absence of cuticular bars near the claw bases; from *Is. marii* by the absence of cuticular bars near the claw bases and by the simplicity of buccal armature; from *Is. baicalensis* by the thin macroplacoids and by the absence of points in the buccal

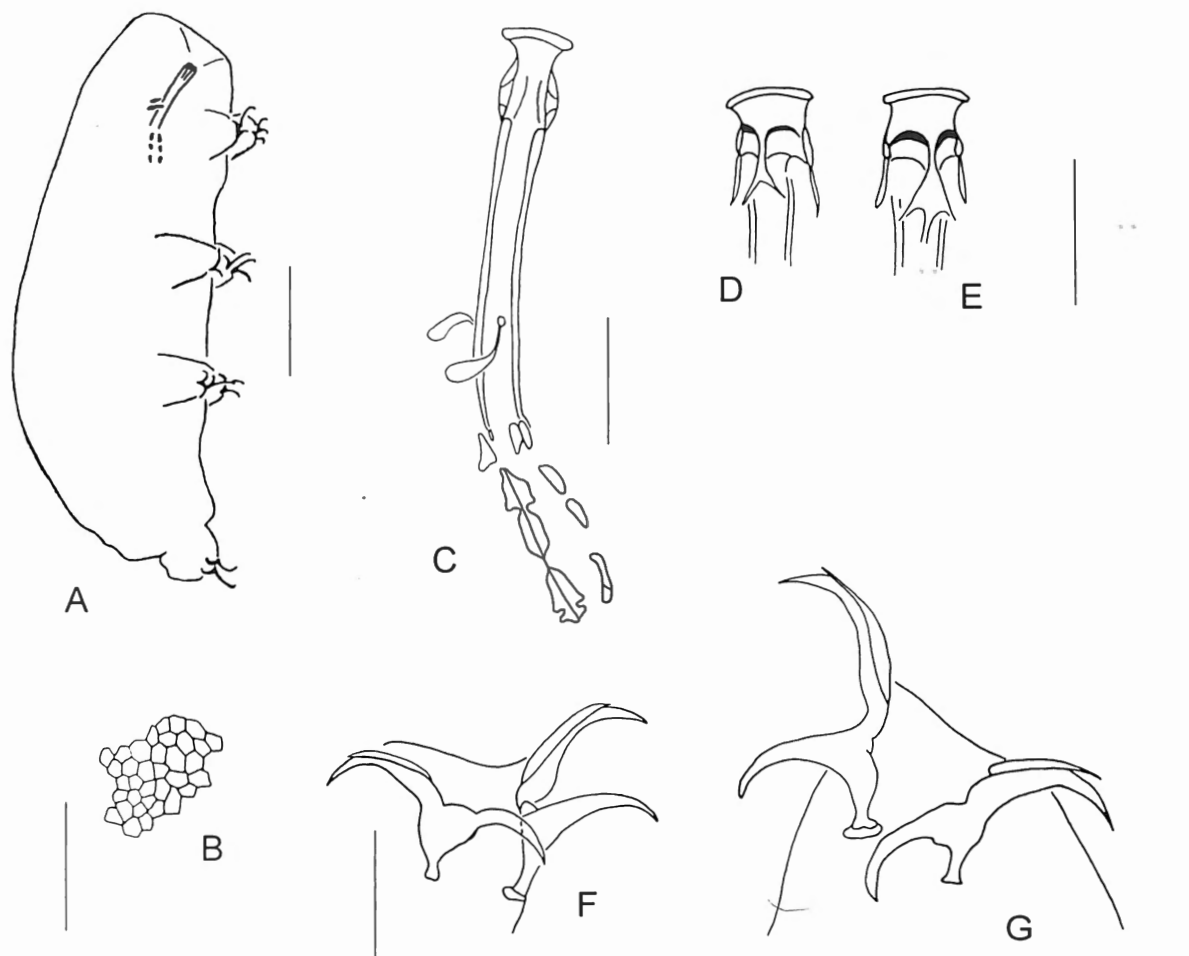


Fig. 3. *Isohypsibius kotovae* sp. nov., A. Habitus. B. Dorsal sculpture. C. Bucco-pharyngeal apparatus. D. Buccal armature, dorsal view. E. Buccal armature, ventral view. F. Claws of leg II. G. Claws of leg IV. Scale bars: Fig. A 100  $\mu$ m, Figs C-G 10  $\mu$ m.

cavity; from *Is. palmai* and *Is. wilsoni* by the presence of the posterior constriction of the third macroplacoid, smaller dimensions of the reticulation meshes and by the absence of cuticular bars near the claw bases.

#### 4. *Isohypsibius baldioides* sp. n. (Tab. 4, Fig. 4)

HOLOTYPE. Slide number 119(3) (sex indet).

TYPE LOCALITY. A stream between Vuoksa and Suhodolskoe lakes («Losevski» rapids), water moss near the shore (Priozerski Distr., St. Petersburg Prov.).

PARATYPES. Slide numbers 119(4), 120(1), 120(2), 120(3) from the same location and from the Lembolovskoje lake.

ETYMOLOGY. This species is extremely similar to *Is. baldii* RAMAZZOTTI, 1945.

#### DESCRIPTION

Length of adult animals 234-289 (holotype length 289). Body white. Eye spots absent. Cuticle sculpture very similar to the one described by BERTOLANI & BALSAMO (1989) in *Is.*

*baldii*. Dorsally it consists of wide, flat granules, partially fused, with a tendency to form a reticulate pattern. Anterior to the level of the first pair of legs, the dorsal sculpture often becomes clearly reticulate. Ventral sculpture consists of large indistinct granules.

Buccal armature with thin latero-dorsal and latero-ventral ridges only. Pharyngeal bulb oval and containing apophyses and three thin macroplacoids. First macroplacoid usually slightly longer than the second, the third being the longest (for dimensions see Table 4).

Legs with claws, typical of the genus *Isohypsibius*. Claws of legs IV slightly larger than claws of legs I-III. Claws of legs I-III with minute accessory points. Claws of legs I-III with lunules, usually better visible on external claws. Near bases of internal claws of legs I-III cuticular bars present (scarcely visible in some specimens). Claws of legs IV with well developed accessory points and lunules.

Eggs unknown.

#### REMARKS

*Isohypsibius baldioides* sp. nov. is mostly similar to *Is. baldii* by the type of cuticular sculpture. It can be distin-

Table 4. Measurements of *Isohypsibius baldioides* (in  $\mu\text{m}$ ) (N = 8).

| Measurements | Holotype | Mean (Range)     | Standard deviation |
|--------------|----------|------------------|--------------------|
| Btl          | 30.5     | 30.1 (27.9-34.1) | 1.9                |
| Ssi          | 20.6     | 21.1 (19-23)     | 1.2                |
| Ptss (in %)  | 67.5     | 69.9 (67.5-73.8) | 2.3                |
| Btd          | 1.5      | 1.8 (1.5-2)      | 0.2                |
| Prl          | 10.4     | 11.2 (10.2-12)   | 0.9                |
| Fpl          | 3.0      | 3.1 (2.9-3.2)    | 0.1                |
| Spl          | 3.0      | 3.1 (3-3.4)      | 0.2                |
| Tpl          | 4.0      | 4.0 (3.6-4.3)    | 0.2                |
| Ptprl (in %) | 34.1     | 37.2 (34.1-41.4) | 2.9                |
| U4e          | 28.1     | 23.1 (20-28.1)   | 2.6                |
| U4I          | 21       | 17.4 (14.3-21)   | 2.6                |
| PtU4e (in %) | 92.1     | 76.8 (65.6-92.1) | 8.7                |

guished from this species by the larger dimensions (234-289 to 121-195 in *Is. baldii*) and by the presence of cuticular bars on the legs 1-3.

#### Acknowledgements

I would like to thank Mrs. J. KOTOVA (St. Petersburg) for collecting some of the material studied here. I am most grateful to Prof. R. PILATO (University of Catania, Italy) for sending me the material of *Is. tuberciculatus* and for examining and discussing my material. This work was partially supported by the Russian Academy of Sciences program "Investigation of the current biodiversity dynamics in freshwater ecosystems".

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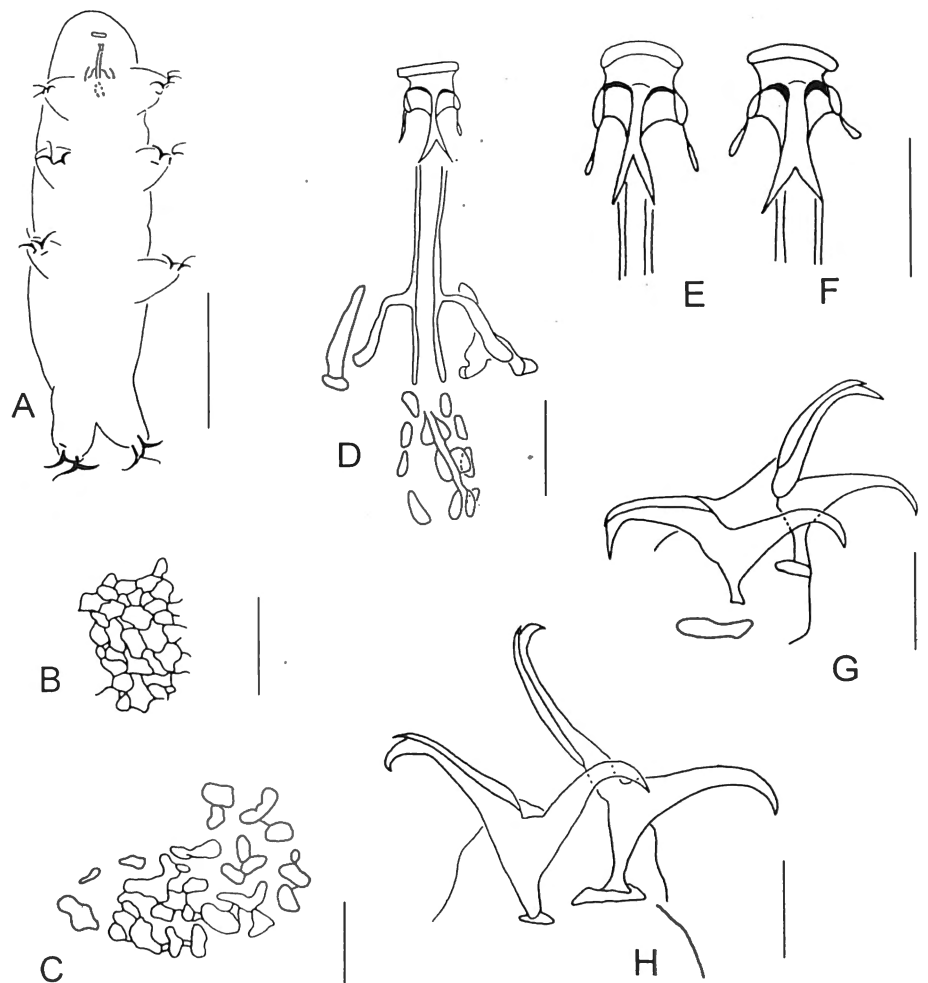


Fig. 4. *Isohypsibius baldioides* sp. nov., A. Habitus. B. Dorsal sculpture of the cephalic region. C. Dorsal sculpture of the caudal region. D. Bucco-pharyngeal apparatus. E. Buccal armature, dorsal view. F. Buccal armature, ventral view. G. Claws of leg II. H. Claws of leg IV. Scale bars: Fig. A 100  $\mu\text{m}$ , Figs C-H 10  $\mu\text{m}$ .

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