Redescription of *Macrobiotus tridigitus* Schuster, 1983
and the erection of a new genus of Tardigrada
(Eutardigrada, Macrobiotidae)

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Abstract
Based on claw morphology *Macrobiotus tridigitus* is transferred to the new genus *Schusterius*. Claws of the genus *Schusterius* differ from those in the genera *Calcarobiotus* and *Macrobiotus* in the unusually well-developed accessory points which are transformed into very long and thin additional claws, arranged above double claws on each leg. A redescription of *Schusterius tridigitus* comb. nov. based on the holotype and the paratype is also given.

Keywords: Macrobiotus tridigitus, Schusterius gen. nov., Schusterius tridigitus comb. nov., Tardigrada

Introduction
Up to the present 12 genera have been described in the family Macrobiotidae. The largest genus of the family, *Macrobiotus*, is represented by at least 140 species (Guidetti and Bertolani 2005). Large variability in the claw and buccal apparatus morphology within the genus *Macrobiotus* (before 1980 the only genus in the family) has led to re-examination of many species and their transfer into new genera in the last years (e.g. Schuster et al. 1980; Pilato and Binda 1987, 1989; Binda and Pilato 1992; Bertolani and Biserov 1996; Claxton 1998; Guidetti and Bertolani 2001; Guidetti and Pilato 2002). Bertolani and Biserov (1996) erected two new genera in the family Macrobiotidae based on the claw structure and stated they are two different phyletic lines. Also, Guidetti and Bertolani (2001) stated that such high variability of claw morphology in Macrobiotidae suggests that in this family more than one phyletic line may be present. In 1993 Dastych described a new genus in Macrobiotidae based exclusively on the claw morphology. These papers show that the claw morphology is very important at the generic level in Macrobiotidae and also in the whole order Eutardigrada. Nevertheless, the species currently assigned to the genus *Macrobiotus*
still vary significantly in the claw and buccal apparatus morphology. It suggests that more genera will be established based on these characters.

After re-examination of the holotype and a paratype of *M. tridigitus* we have concluded that the claw morphology is clearly different from that of *Macrobiotus* and decided to transfer this species to a new genus.

**Material and methods**

Two specimens (holotype and paratype) of *M. tridigitus*, in very good condition, loaned from Bohart Museum (University of California) were re-examined.

Buccal tube length and the level of the stylet support insertion point were measured from the anterior margin of the stylet sheaths. Buccal tube widths were measured as the external diameters at the level of the stylet support insertion point. 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). Lengths of claws were measured from the base of the claw to the top of the primary branch.

In the description of the holotype, measurements of the paratype are given in parentheses. The *pt* index is given after the μm value (in square brackets and italics). Due to unfavourable orientation of the holotype only claws of the paratype were measured. All measurements are given in micrometres (μm).

Photomicrographs, drawings and measurements were made using a phase contrast microscope associated with a *camera lucida*.

**Schusterius** gen. nov.

**Diagnosis**

Claws similar to those of the *Calcarobiotus* type (with primary branches only slightly longer than secondary branches), Y-shaped but with extremely developed accessory points connected to the primary branch by a flexible light-refracting portion. Bucco-pharyngeal apparatus of the *Macrobiotus* type probably with 10 peribuccal lamellae.

**Type species**

*Schusterius tridigitus* (Schuster, 1983) comb. nov.

**Etymology**

The new genus is named after Professor R. O. Schuster who described *Macrobiotus tridigitus* from Tierra del Fuego (Argentina).

**Schusterius tridigitus** (Schuster, 1983) comb. nov.

(Figures 1–7)

**Description**

Holotype (paratype): body length 235.0 (295.0) (Figure 1). Body colourless, eyes absent. Cuticle smooth, without granulation or pores. Mouth terminal, probably with 10
peribuccal lamellae (Figure 2). Bucco-pharyngeal apparatus of *Macrobiotus* type with ventral lamina 16.0 [59.3] (19.0 [57.6]) long and with one bend in anterior part (Figures 2, 3, 5, 6). Buccal tube 27.0 (33.0) long and 3.5 [13.0] (4.0 [12.1]) wide. Stylet supports inserted on buccal tube walls at 21.0 [77.8] (26.0 [78.8]) of its length. Oral cavity armature poorly developed. On dorsal side all teeth absent. On ventral side first two bands of teeth absent and only one median tooth (in shape of transversal ridge) present in third band. Pharyngeal bulb oval with three oval macroplacoids without constrictions, similar in length, and microplacoid. First macroplacoid 4.0 [14.8] (4.5 [13.6]) long, second 3.0 [11.1] (4.0 [12.1]), third 3.0 [11.1] (4.0 [12.1]). Microplacoid 2.0 [7.4] (2.3 [7.0]) long. Macroplacoid row 12.0 [44.4] (15.0 [45.5]) long, placoid row 14.0 [51.9] (18.0 [54.5]) long.

Claws similar to *Calcarobiotus* type claws (primary branches very similar in length) with 2-1-1-2 configuration, Y-shaped but with extremely developed, very long and thin accessory points connected to primary branch by flexible light-refracting portion (Figures 3, 4, 7). Measurements of external claws in paratype: accessory points of I pair 11.0 [33.3];
primary branch of II pair of legs 8.0 [24.2]; secondary branch of II pair of legs 7.5 [22.7]; accessory points of II pair 11 [33.3]; primary branch of III pair of legs 9.0 [27.3]; secondary branch of III pair of legs 8.0 [24.2]; accessory points of III pair 12.5 [37.9]; primary branch of IV pair of legs 7.0 [21.2]; secondary branch of IV pair of legs 7.0 [21.2]; accessory points of IV pair 10 [30.3]. Smooth lunules present on all legs. Cuticular bars and other cuticular structures on legs absent.

Eggs unknown.

Type locality
South America, Argentina, Tierra del Fuego, Sierra Martial.

Material examined
Holotype and paratype: Argentina, Tierra del Fuego, Sierra Martial, altitude 2000–2500 feet (tree line), cryptogams, 19 January 1979, coll. Arthur M. Shapiro. Holotype and
paratype are deposited in the Entomology Collection in Bohart Museum, University of California, Davis, USA.

Discussion

While Schuster (1983) was describing *Macrobiotus tridigitus* many of the currently existing genera were still assigned to the genus *Macrobiotus*. In the last few years researchers have started to pay more attention to the claw morphology. It is very likely that if Schuster was describing *M. tridigitus* today, he would assign it to a new genus. *Schusterius* gen. nov. is the only known Tardigrada species which has such strongly developed accessory points, which in our opinion justifies the decision of erecting the new genus for it.

The new taxon belongs to the family Macrobiotidae and is closely related to the genus *Calcarobiotus* Dastych, 1993 by the shape of the double claws (definition of *Calcarobiotus* type claws amended by Guidetti and Bertolani 2001) (Figures 7, 8) and to *Macrobiotus* Schultze, 1834 (Figure 9) by its buccal apparatus. *Schusterius* gen. nov. differs from these two genera in the extremely developed accessory points on the claws. These long accessory points are connected to the primary branches of the external and internal claws by a flexible light-refracting portion. This character seems to be apomorphic and it is not known in other genera of the Macrobiotidae. However, claws with a similar appearance are present in the genus *Milnesium* Doyère, 1840, *Ramazzottius* Binda and Pilato, 1986, and *Ramajendas* Pilato and Binda, 1990 (Figures 9–12), but in these three genera not just the accessory points but the entire main branches of the claws are thin and elongated. In the genus *Milnesium* and *Ramazzottius* the main branch is completely separated and transformed into an additional claw, but in *Ramajendas* the main branch is still weakly connected with the secondary branch by a light-refracting unit.

At this stage it is difficult to estimate the evolutionary importance of the extreme development of accessory points into additional claws but it seems that it is a true apomorphy. Until now only one species, *S. tridigitus*, has been ascribed to the genus *Schusterius*. It is known only from two specimens collected in Tierra del Fuego and no ecological or detailed environmental data are known.

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Figures 7–12. Claws of a few Eutardigrada genera. (7) *Schusterius tridigitus* comb. nov. (Macrobiotidae), external claw of the III pair of legs (holotype). (8) *Calcarobiotus longinoi* (Kaczmarek et al. 2006b) (Macrobiotidae), external claw III. (9) *Macrobiotus marlenae* Kaczmarek and Michalczyk, 2004 (Macrobiotidae), external claw IV (from Kaczmarek and Michalczyk 2004). (10) Claws of *Ramazzottius oberhaeuseri* type (Hypsibiidae), external claws IV (from Binda and Pilato 1986). (11) *Ramajendas renaudi* (Hypsibiidae), external claws IV (from Pilato and Binda 1990). (12) *Milnesium katarzynae* Kaczmarek et al., 2004 (Milnesiidae), internal claw IV (from Kaczmarek et al. 2004). Figures 8–12 reproduced with permission.
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