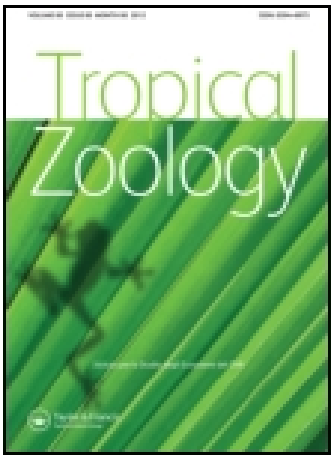

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Some tardigrades from Central Africa with the description of two new species: Macrobiotus ragonesei and M. priviterae (Eutardigrada Macrobiotidae)

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Some tardigrades from Central Africa with the description of two new species: *Macrobiotus ragonesei* and *M. priviterae* (Eutardigrada Macrobiotidae)

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Ten species of tardigrades are reported from Central Africa. *Isohypsibius arbiter* Binda 1980 is new for Africa; two species, *Macrobiotus ragonesei* and *Macrobiotus priviterae* are new to science.

Macrobiotus ragonesei has two macroplacoids and microplacoid, and areolated eggs with conical processes sculptured in the basal portion and unsculptured in the terminal portion.

Macrobiotus priviterae is similar to *M. richtersi* Murray 1911, *M. peteri* Pilato et al. 1989, and *M. chieregoi* Maucci et al. 1980 but differs from them by having eyes, and in the claw and egg characters; it is also similar to *M. vanescens* Pilato et al. 1991 and to *M. danielae* Pilato et al. 2001 but differs from them in claw and egg characters.

The egg of *Minibiotus africanus* Binda & Pilato 1995, unknown so far, is described.

KEY WORDS: tardigrades, Central African fauna, *Macrobiotus ragonesei* n. sp., *Macrobiotus priviterae* n. sp.

INTRODUCTION, MATERIAL AND METHODS

For some years we have been interested in the African tardigrade fauna. We have found strong differences between the North African and South African faunas. In this note we report on 10 species, two of which are new to science and one is new for Africa.

Specimens and eggs were found in moss, lichen and liverwort samples collected in Guinea (Sangaredi) and the Democratic Republic of Congo (North Kivu: outskirts of Mohanga and Lukanga). All specimens are mounted in polyvinyl lactophenol and deposited in the collection of M.G. Binda and G. Pilato (Dipartimento di Biologia Animale dell'Università di Catania).

SYSTEMATICS

Echiniscus perarmatus Murray 1907

Material examined. Democratic Republic of Congo, Mohanga: 8 specimens from a moss sample (*Entodon* sp.).

Our specimens are up to 225 µm long. Appendage A is thinner and generally shorter than appendage E, but in one specimen (218 µm long) appendage A (37.4 µm long) is longer than appendage E (35.3 µm). We wish to emphasize here a character till now overlooked. The ventral surface has two types of sculpture: the anterior and posterior extremities have a very fine, homogeneous punctuation similar to that in many other species. The central portion of the ventral surface has two series of parallel striae which cross forming an almost right angle with each other and forming an angle of almost 45° with respect to the longitudinal body axis. We compared the African specimens with one specimen from the Hawaii Islands, with some Australian specimens (kindly sent by S. Claxton) and with some specimens from Florida (kindly sent by D. Christenberry).

The species, reported from South Africa (locus typicus), North and South America, Hawaii Islands and Australia, should probably be considered cosmopolitan.

Macrobiotus ragonesei n. sp. (Figs 1-2)

Material examined. Democratic Republic of Congo, Mohanga: holotype, 4 paratypes and 12 eggs, some of which containing a fully developed embryo, in moss samples (*Campylopus* cfr. *fragilis*).

Description of the holotype. Body length 318 µm (Fig. 1A); colourless; eyes present; cuticle smooth with round and ellyptical pearls; very small dots on the hind legs.

Bucco-pharyngeal apparatus of *Macrobiotus* type (Fig. 1B-C); mouth terminal with 10 peribuccal lamellae, an anterior band of fine teeth, an evident posterior band of teeth (where the caudals are more developed than the others but not triangular in shape); three dorsal and three ventral transverse ridges. Buccal tube, measured from the mediodorsal ridge of the buccal armature to the base of pharyngeal

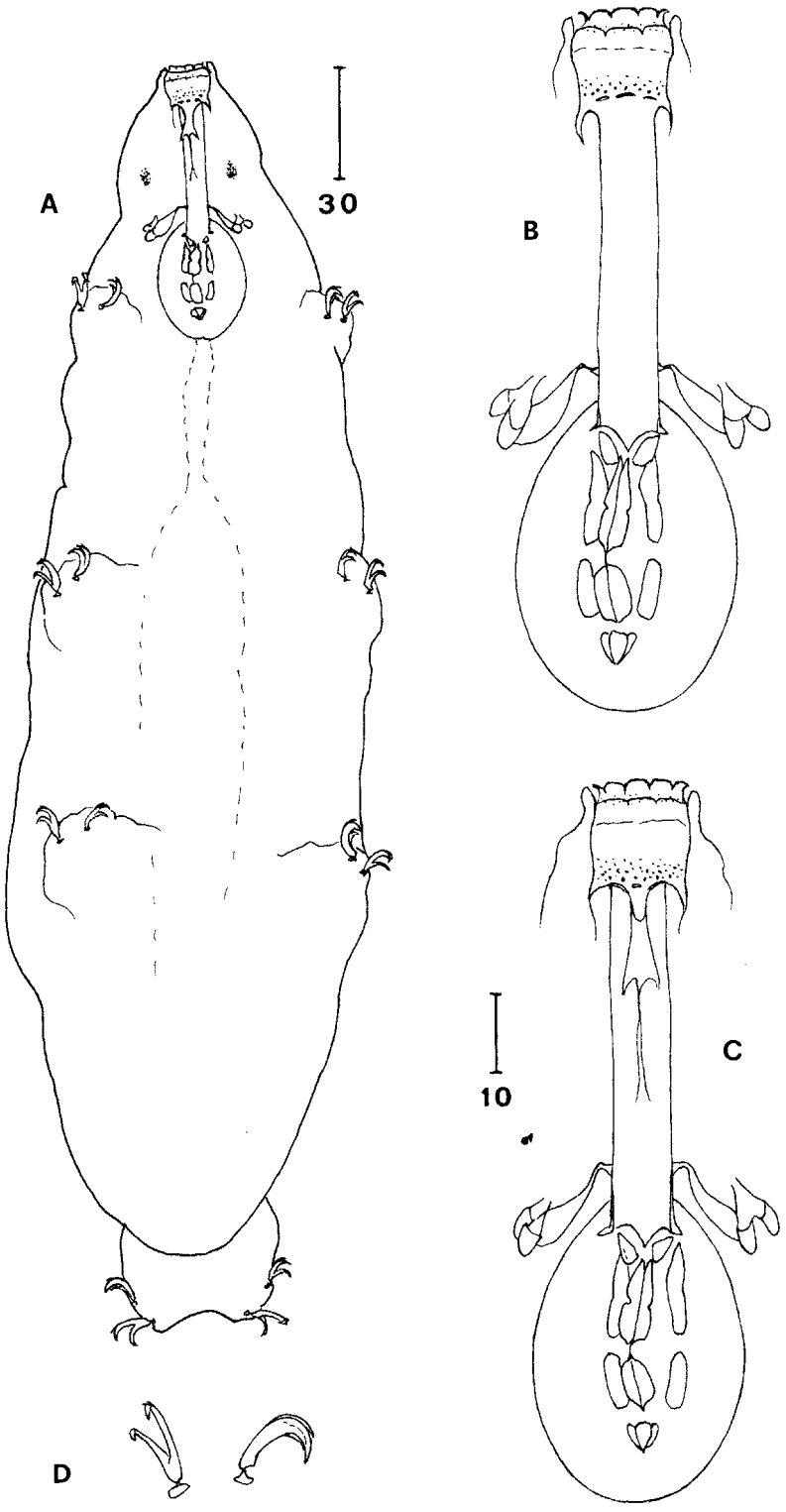

Fig. 1. — *Macrobiotus ragonesei* n. sp. A, habitus; B, bucco-pharyngeal apparatus on dorsal view; C, bucco-pharyngeal apparatus on ventral view; D, claws (of the third pair of legs). Scale bars in µm.

apophyses, 37.1 µm long and 6.5 µm wide (*pt* = 17.5); the index *pt* is the per cent ratio between the length of a structure and the length of the buccal tube measured as above (PILATO 1981). Stylet supports inserted on the buccal tube at 79.9% of its length (*pt* = 79.9). In a specimen still in the egg the buccal tube is 31.1 µm long and 4.4 µm wide (*pt* = 14.1), and the stylet supports are inserted on the buccal tube at 79.5% of its length.

Pharyngeal bulb, 32.7 × 22.1 µm, containing apophyses, two rod-shaped macroplacoids and microplacoid. First macroplacoid, with a central constriction, 9.1 µm long (*pt* = 24.5), second macroplacoid 6.5 µm (*pt* = 17.5), microplacoid 3.6 µm (*pt* = 9.7); placoid row (including the microplacoid) 20.8 µm long (*pt* = 56.1), excluding the microplacoid 16.7 µm (*pt* = 45).

Claws of *hufelandi* type (Fig. 1D) with accessory points on the main branches. Outer claws on the third pair of legs 11.3 µm (*pt* = 29.6); inner claws on the same legs 10.3 µm (*pt* = 27.8). The unfavourable orientation does not allow us to measure the claws on the hind legs. Small, smooth lunules are present. A cuticular bar is present near the lunules on the first three pairs of legs; this structure is almost invisible in the holotype (since the legs are contracted), but they are evident in the paratypes.

Eggs freely laid, spherical and provided with conical processes (10-12 in the light microscope section) (Fig. 2); 11-12 finely dotted areolae are present around the base of each process. The diameter is 92-100 µm excluding the processes, 126-136 µm including them. Processes conical, with a basal portion covered by a reticu-

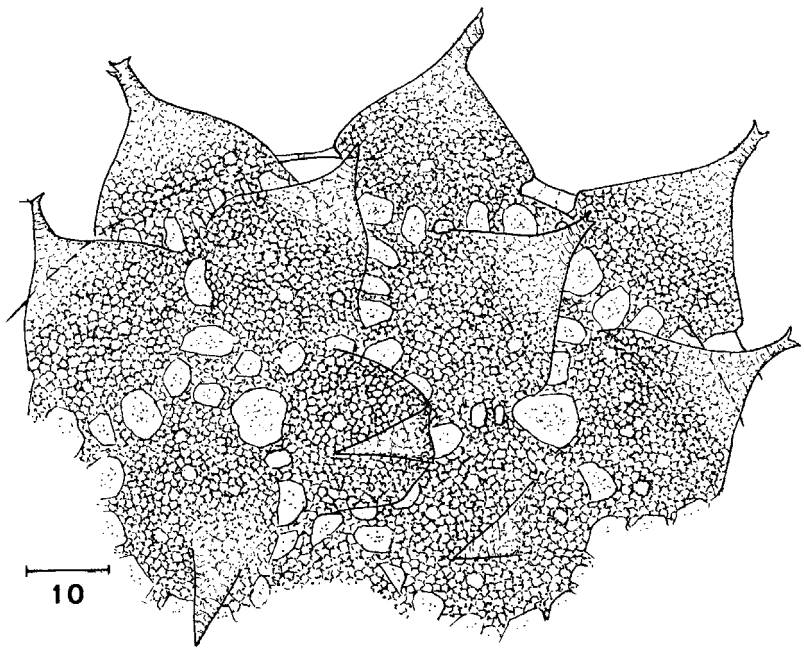

Fig. 2. — *Macrobiotus ragonesei* n. sp., detail of the egg. Scale bar in µm.

lar sculpture with small polygonal meshes of different size, and a long, flexible, terminal portion (forked in some of them) with faint sculpture forming a slightly evident annulation. Processes height 20-23 µm, their basal diameter 20-26 µm in the largest eggs.

The paratypes are similar to the holotype.

Derivatio nominis. The species is named *M. ragonesei* in honour of Mr Bruno Ragonese who kindly collected the moss samples.

Macrobiotus ragonesei differs from *M. spectabilis* Thulin 1928 and from *M. grandis* Richters 1911 for some characters of the buccal armature and eggs; in the buccal armature of *M. ragonesei* the anterior teeth of the posterior band are less developed than the others, whereas in *M. grandis* and *M. spectabilis* the anterior teeth of the band are more developed than the others and triangular in shape (Maucci & Pilato 1974). The egg processes of *M. ragonesei,* differently from those of *M. spectabilis* and *M. grandis*, have a well evident reticular sculpture in the basal portion.

Macrobiotus ragonesei differs from *M. pallarii* Maucci 1954 by having smaller cuticular pearls, and for some characters of the eggs (higher number of areolae and their shape; distal portion of the conical process unsculptured).

The new species differs from *M. bondavallii* Manicardi 1989 in the following features: an anterior band of teeth present in the buccal armature; lunules smaller and smooth; terminal portion of egg processes unsculptured.

Macrobiotus ragonesei differs from *M. nelsonae* Guidetti 1998 in the following characters: stylet supports inserted on the buccal tube in a more cephalic position (*pt* = 78-80 in *M. ragonesei*, 79.4-84.5 in *M. nelsonae* according to Guidetti 1998); some characters of the eggs (apical portion of the processes thinner and flexible; less evident and less regular reticular sculpture; a single series of areolae around each process).

Macrobiotus radiatus Pilato, Binda & Catanzaro 1991

Material examined. Democratic Republic of Congo, Mohanga: 6 specimens in a liverwort sample (*Plagiochila porelloides*) and a moss sample (*Entodon* sp.); Lukanga: 29 specimens and 21 eggs in an unidentified lichen sample and in a moss sample (*Brachythecium velutinum*).

The species was described from Tanzania.

Macrobiotus priviterae n. sp. (Figs 3-4A)

Material examined. Guinea, Sangaredi: holotype, 2 paratypes and 22 eggs some of which containing a fully developed embryo, in a moss sample (*Isopterygium tenerum*).

Description of the holotype. Of the three specimens found, two were contracted and thus neither of them can be designed as holotype; the third specimen seems to be young, having the buccal tube of the same length as a specimen within the egg. Nonetheless, we think that we are justified in describing the new species using

the third specimen as holotype, because: the morphological characters are identical in the newborns and adults; the values of the quantitative characters refer to a specimen of well determined body length; we have been able to study many eggs (also embryonate) with exclusive characteristics; it is very difficult to obtein other specimens.

Body length 184 µm (Fig. 3A); colourless; eyes present; cuticle smooth without pearls; very small dots present on the legs. Bucco-pharyngeal apparatus of *Mac-*

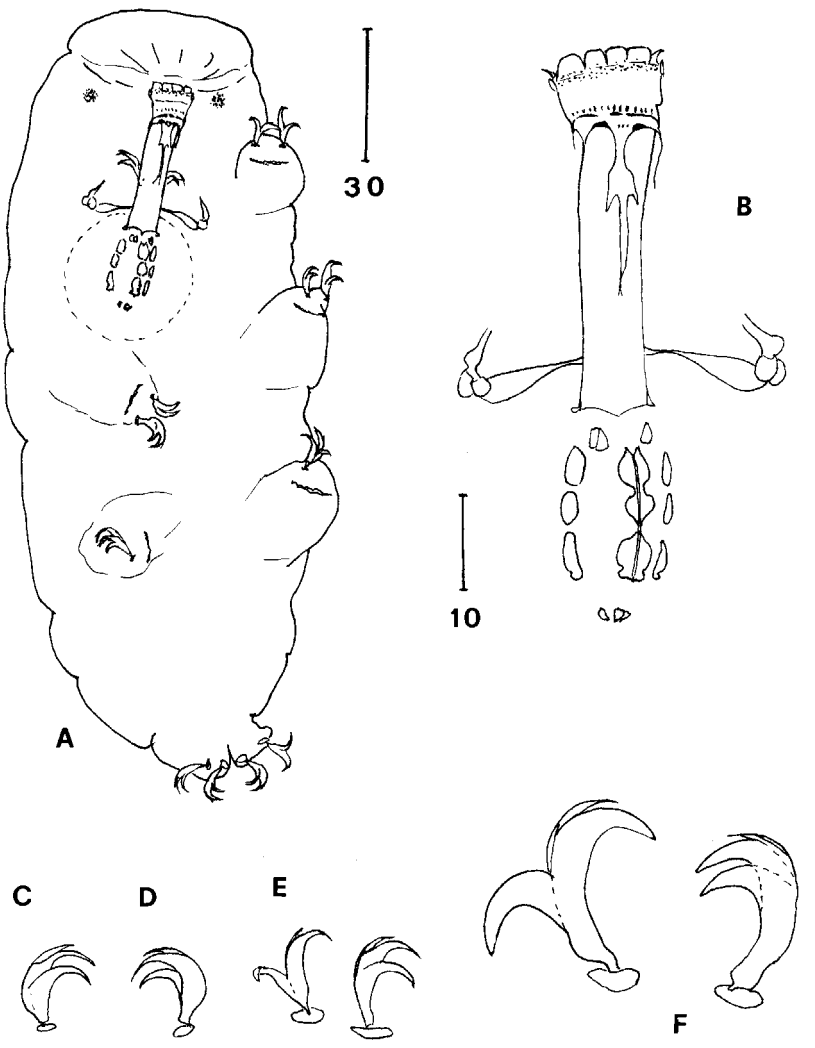

Fig. 3. — A-E, *Macrobiotus priviterae* n. sp., A, habitus; B, bucco-pharyngeal apparatus; C, claws of the second pair of legs; D, claw of the third pair of legs; E, claws of the hind legs. F, *Macrobiotus richtersi* Murray 1911: claws of the third pair of legs. Scale bars in µm.

robiotus type (buccal tube rigid with ventral strengthening bar) (Fig. 3B); mouth terminal with 10 peribuccal lamellae. A band of small teeth present in the anterior portion of the buccal cavity; a crown of triangular teeth and three dorsal and three ventral transverse ridges present in the posterior portion of that cavity. Some triangular teeth joined two by two. Buccal tube, measured from the medio-dorsal ridge to the base of the pharyngeal apophyses, 31.6 µm long and 6.7 µm wide (*pt* = 21.2). Stylet supports inserted on the buccal tube at 79.8% of its length (*pt* = 79.8). Pharyngeal bulb, 37.5 × 34.7 µm, containing apophyses, 3 rod-shaped macroplacoids and a small microplacoid quite distant from the third macroplacoid. First macroplacoid length 4.2 µm (*pt* = 13.3), second macroplacoid 3.6 µm (*pt* = 11.4), third macroplacoid, with a preterminal constriction, 5.1 µm (*pt* = 16.1), microplacoid 1.9 µm (*pt* = 6); entire placoid row (including microplacoid) 18 µm (*pt* = 57), excluding microplacoid 14.2 µm (*pt* = 44.9).

Claws of *hufelandi* type (Fig. 3C-E); the distal portion of both the main and the secondary branches abruptly narrowed and curved almost at a right angle to the basal portion. Accessory points present. It is very difficult to measure the claw length which may appear different in the same specimens due to the claw orientation. Outer claws of the second pair of legs about 10.3 µm long (*pt* = 32.6); of the hind legs about 10.5 µm (*pt* = 33.2). Smooth lunules present. A cuticular bar present near the lunules, on the first three pairs of legs.

Eggs freely laid, spherical and with trunco-conical processes (14-17 in the light microscope section) (Fig. 4A). Diameter 90-107 µm excluding the processes, 115-131 µm including them. Processes (height 11.8-15 µm, basal diameter 12.9-16.3 µm), characterized by a very dense reticular sculpture with very small meshes. Stout terminal portions with thorn-shaped projections. Six circular areolae surround the base of each process. Ridges delimiting the areolae sculptured. Areolae with a central area, almost circular in shape, which appears dark with some bright dots when examined under phase contrast.

Derivatio nominis. The species is named in honour of Maria Privitera, Department of Botany of the University of Catania, who kindly studied the moss and lichen samples where tardigrades were found.

Macrobiotus priviterae is similar to *Macrobiotus vanescens* Pilato et al. 1991 and to *Macrobiotus danielae* Pilato et al. 2001 but differs from them in some characters: the claws, less slender, have a different shape (shorter basal portion; the distal portion of both main and secondary branches narrow abruptly with respect to the basal portion; some differences in the egg characters: only 6 areolae surround the base of each egg process (9 in *M. danielae*, 11-12 in *M. vanescens);* the reticular sculpture of the egg processes is denser since the meshes are smaller; in *M. danielae* the basal areolae do not have a central area sclerified and sculptured.

Macrobiotus priviterae differs from *Macrobiotus peteri* Pilato et al. 1989 in the following features: eyes present, higher value of the *pt* index relative to the buccal tube width and to the claw length, larger eggs with processes different in shape and with different sculpture.

It differs from *Macrobiotus richtersi* Murray 1911 by having eyes, claws more slender and different in shape (Fig. 3C-F), and in the characters of the eggs.

The new species differs from *M. chieregoi* Maucci et al. 1980, by having eyes and in some characters of the eggs (process shape, central portion of the egg areolae sclerified and sculptured).

Minibiotus africanus Binda & Pilato 1995 (Fig. 4B)

Material examined. Democratic Republic of Congo, Mohanga: 15 specimens and 4 eggs, one of which containing a fully developed embryo, in a moss sample (*Entodon* sp.) and in an unidentified liverwort sample.

The species was originally described on only two specimens from the National Park of Kilimanjaro (Tanzania). The eggs were unknown.

The characters of the adults agree with the original description of the species. Having noted a mistake in the former description of the species as regards the dimensions of the holotype, we correct it here.

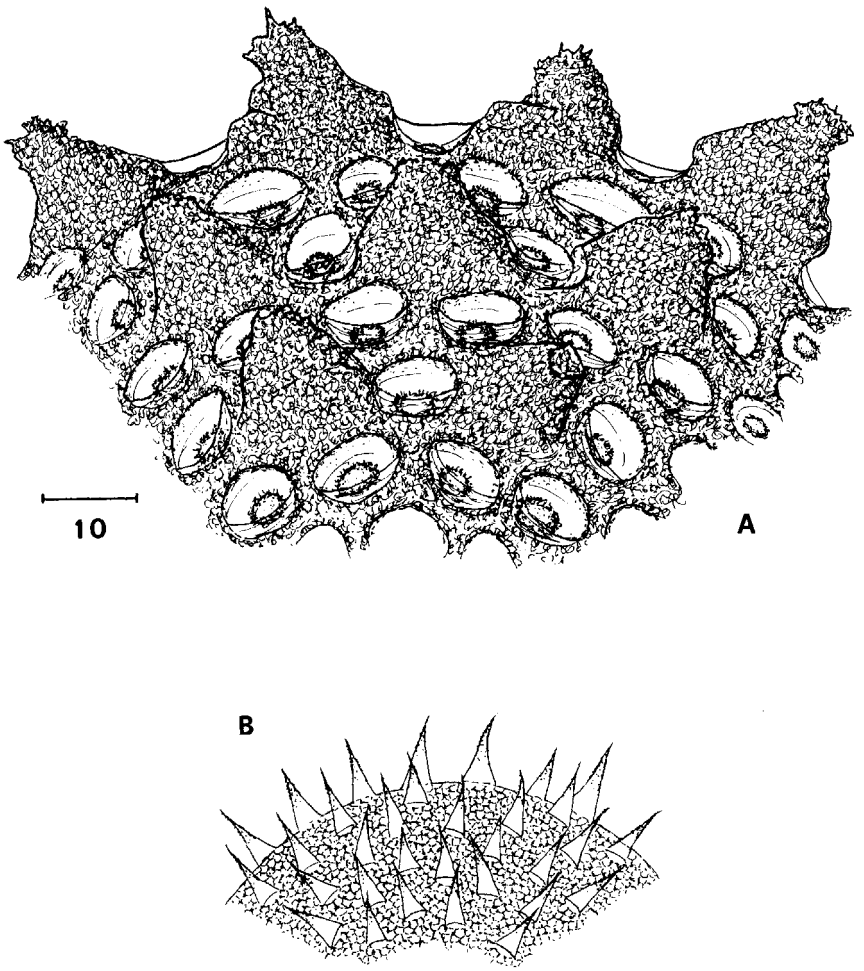

Fig. 4. — A, detail of the egg of *Macrobiotus priviterae* n. sp. B, detail of the egg of *Minibiotus africanus* Binda & Pilato 1995. Scale bar in µm.

The eggs, freely laid, are spherical (Fig. 4B) and provided with conical processes (31 in the light microscope section). The diameter is 58-67 µm excluding the processes, 71.5-80 µm including them; the processes are slender, sharp cones, smooth in the basal portion and slightly rough in the terminal portion; they are 7.3-7.9 µm long; the basal diameter is 3-3.6 µm in the smallest egg, 3.1-4.3 µm in the largest egg; the egg shell has a reticular, very regular sculpture with homogeneous, isodiametric polygonal meshes.

Dimensions of the holotype. Body length 270 µm; buccal tube 28 µm long and 2.6 µm wide (*pt* = 9.3). Stylet supports inserted on the buccal tube at 69% of its length (*pt* = 69). Placoid row length, microplacoid included, 11.1 µm (*pt* = 39.6), microplacoid excluded 9.8 µm (*pt* = 35); first macroplacoid 5.6 µm long (*pt* = 20), second macroplacoid 3.6 µm (*pt* = 12.9), microplacoid 1.1 µm (*pt* = 3.9). Outer and inner claws on the third pair of legs 7.2 µm (*pt* = 25.7) and 6.8 µm (*pt* = 24.3) long, respectively; posterior and anterior claws on the hind legs 7.9 µm (*pt* = 28.2) and 7.8 µm (*pt* = 27.8) long, respectively.

Minibiotus intermedius Plate 1888

Material examined. Democratic Republic of Congo, Mohanga: 3 specimens and 1 egg in a moss sample (*Entodon* sp.).

The cuticle is smooth, fine dots are present on the legs. The species is considered cosmopolitan.

Isohypsibius lunulatus (Iharos 1966)

Material examined. Democratic Republic of Congo, Lukanga: 4 specimens in a moss sample (*Brachythecium velutinum*).

The species is reported from Europe, Africa, North America and South America (Patagonia).

Isohypsibius arbiter Binda 1980

Material examined. Democratic Republic of Congo, Lukanga: 5 specimens in a moss sample (*Brachythecium velutinum*).

The species, widespread in Italy, is new for Africa.

Isohypsibius prosostomus Thulin 1928

Material examined. Democratic Republic of Congo, Lukanga: 5 specimens in an unidentified lichen sample.

The species is considered cosmopolitan.

Diphascon pingue (Marcus 1936)

Material examined. Democratic Republic of Congo, Mohanga: 3 specimens in a moss sample (*Entodon* sp.).

Pilato & Binda (1977) and, more recently, Pilato & Binda (1998: 182, fig. 1d-f) provided a contribution to the correct diagnosis of this species. The African specimens show the characters pointed out by those authors.

A very wide geographical distribution is attributed to the species, but in our opinion many reports must be confirmed.

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