

## *Mopsechiniscus frenoti* sp. n., a new water-bear (Tardigrada) from Îles Crozet, the Sub-Antarctic

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(With 17 figures)

### Abstract

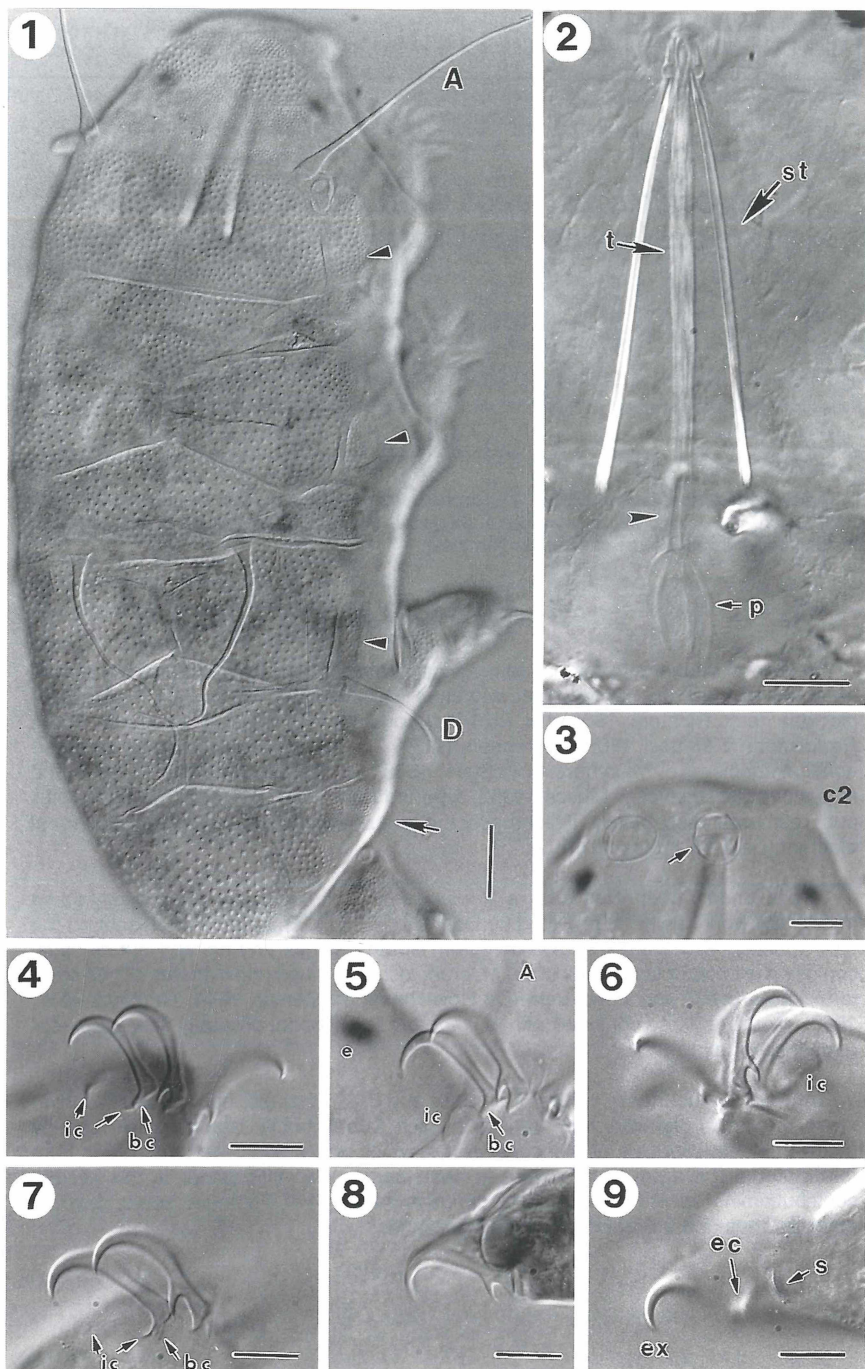
A new semi-terrestrial water-bear, *Mopsechiniscus frenoti* sp. n. from Îles Crozet (Île de la Possession: Sub-Antarctica) is described and figured. The tardigrade species is characterized by long appendages on the second median plate.

### Introduction

Species of the semi-terrestrial genus *Mopsechiniscus* are characterized by a total reduction of the head sensory cirri, a unique feature within the ancient family Echiniscidae (e.g. Richters 1908, Du Bois-Reymond Marcus 1944, Ramazzotti 1962, Ramazzotti & Maucci 1983, Kristensen 1987). The genus is represented by three nominal species, i.e. *M. imberbis* (Richters, 1908), *M. granulosus* Mihelčič, 1967 and *M. tasmanicus* Dastych & Moscal, 1992, reported from South Georgia, the Neotropics and Tasmania, respectively. Presumably the genus exemplifies a Gondwanan faunal element (Dastych & Moscal 1992).

The taxonomy at species level in *Mopsechiniscus* is confusing, but recently some revisionary work has been provided by Dastych (in print). The author re-described the type species, *M. imberbis*, known only from South Georgia and pointed out its usual confusion with other taxa, particularly *M. granulosus*. The taxonomic status of two other forms from Brazil and Venezuela (Du Bois-Reymond Marcus 1944, Grigarick *et al.* 1983), most likely also confused with *M. imberbis*, is still open; probably they represent undescribed taxa.

Through the courtesy of Drs. Y. Frenot and J. L. Chapuis, numerous bryophyte samples with tardigrades from various French Sub-Antarctic islands were recently received. A new species of *Mopsechiniscus*, which was among the tardigrades from this material (i.e. from Îles Crozet), is described below. This paper is the second contribution in a recent revision of the genus and the first of a planned series devoted to tardigrades of the French Sub-Antarctic islands.



## Material and Methods

The specimens were extracted from the bryophytes by the method described in Dastych (1985). Measurements were taken from individuals mounted in gum chloral (Faure's medium). The tardigrades were examined by interference contrast microscopy, photomicrographs were taken with a ZEISS "Axiomat".

The following abbreviations are used in the text and illustrations:

A- lateral appendage (cirrus) A, *bc*- claw basal cusp, *bp*- basal leg plate, *c1*- primary clava (= clava), *c2*- secondary clava (= cephalic papilla), C, D- lateral appendage (cirrus) C, D, *e*- eye spot, *ec*- external cushion on leg, *ex*- external claw, *ga*- granular area (pillars) on leg, *hs*- head shield, *i*- triangular insertion of the paired plate II, *ic*- internal cushion on leg, *m1-m3*: median plate 1-3, *m2d*- dorsal projections on median plate 2, *n*- notch, *np*- neck plate, *p*- placoid, *pl* 1-3: platelet 1-3, *ps*- pseudosegmental plate, *s*- leg spur, *sp*- shoulder plate, *st*- stylet, *su*- subcephalic median plate, *t*- mouth tube, *I*, *II*- the first and the second paired plate.

## Description of the species

### *Mopsechiniscus frenoti* sp. n.

(Figs 1-17)

**DIAGNOSIS.** Small to median sized *Mopsechiniscus* with long filamentous lateral trunk cirri A, (C), D and long dorsal appendages (*m2d*) on median plate 2.

**HOLOTYPE.** Male, 264 µm long, 21.12.1996, coll. Y. Frenot. Deposited in the Zoologisches Museum Hamburg (ZMH Reg. No. A4/99).

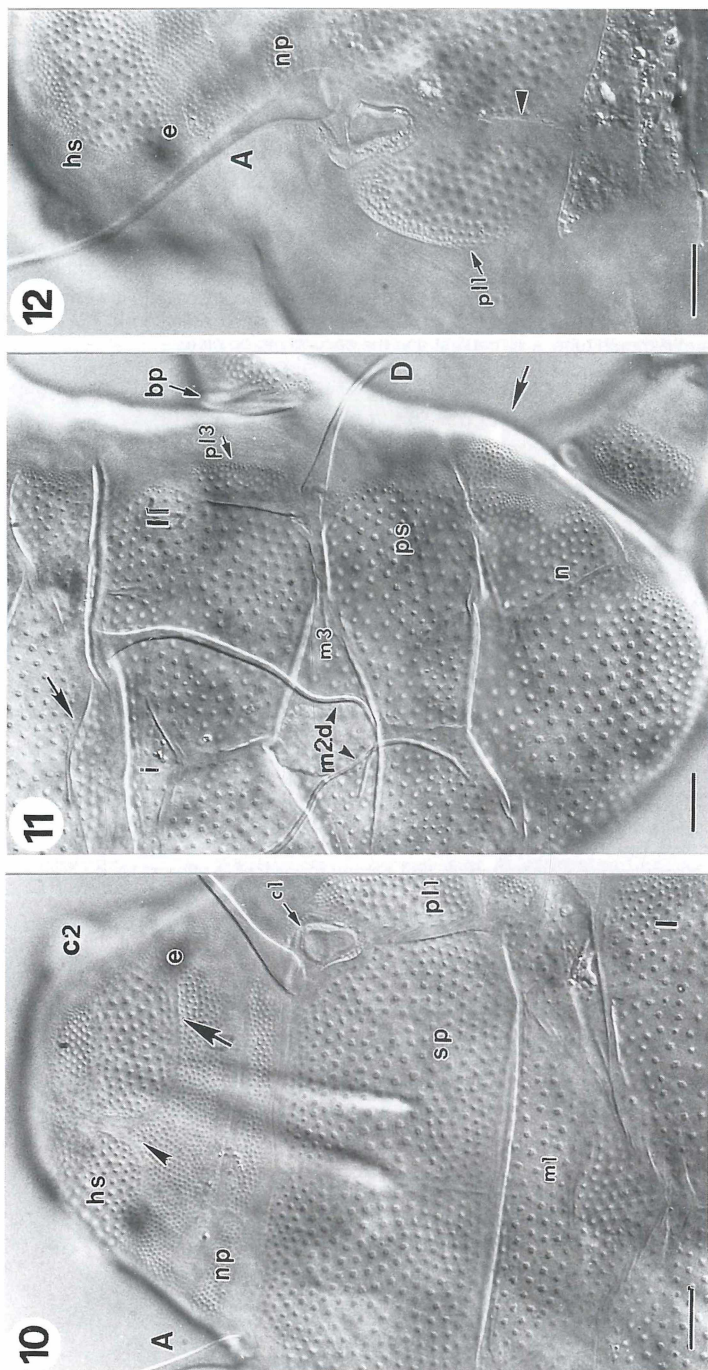
**LOCUS TYPICUS.** Îles Crozet: Île de la Possession, Lac Perdu, 450 m a.s.l., 1.5 km from seashore, moss; 21. 12. 1996, coll. Y. Frenot. The specimens co-occurred with *Echiniscus*, *Macrobiotus*, *Diphascon* and *Calohypsibius* spp.

**PARATYPES.** Three specimens: two of them (♀ and subadult: paratypes No. 1 and 2, respectively) with locality data as for holotype. A third specimen (paratype No. 3, ♂, 235 µm long; Figs 5, 13: no scale bar) with the following data: Île de la Possession, Crique de la Chaloupe, 70 m a.s.l., 700 m from seashore, moss; 31. 12. 1996, coll. Y. Frenot. The specimen was found together with *Macrobiotus* sp. Unfortunately that paratype was lost in attempt to remount it. All paratypes have ZMH Reg. No. A5/99.

**ETYMOLOGY.** The species is named after its collector, Dr. Yves Frenot, of the Biological Station of the Université de Rennes, Paimpont, France.

**DESCRIPTION.** Body delicate, yellow- or orange-reddish, its (sticky?) surface often with small detritus or mineral particles (Fig. 13). Eye-spots blackish and distinct. Body length 235-308 µm (holotype: 264 µm). Dorsal plates more or less poorly formed. Median plates 1-3 usually well formed. One specimen with poorly defined small area between pseudosegmental and terminal plate, set-off indistinctly from the latter by a barely visible transverse cuticular fold.

Figs 1-9. *Mopsechiniscus frenoti* sp. n.: 1- male, dorsally; 2- buccal apparatus; 3- head (♂); 4- claws, leg III; 5- claws, leg I; 6- claws, leg II; 7- claws, leg IV; 8- internal claw, leg III, in lateral view; 9- spur on leg III (Figs 1, 3, 4: holotype. Figs 3-7: ventral view. Scale bar for Fig. 1: 20 µm, all others: 10 µm).



Figs 10-12. *Mopsechiniscus frenoti* sp. n.: 10- anterior of body, dorsally; 11- rear of body, dorsally; 12- anterior of body, dorso-laterally (Figs 10, 11: holotype. Scale bar = 10 µm).

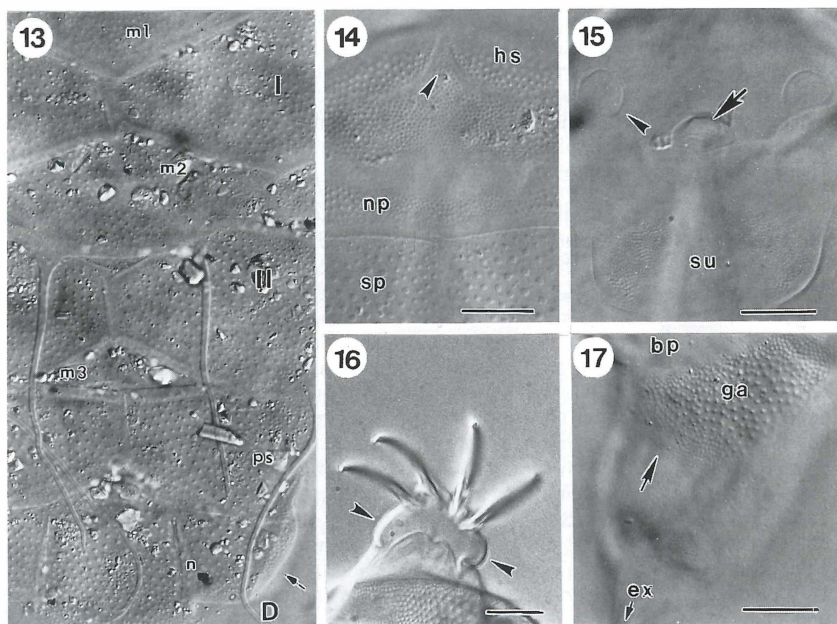
Ventral plates absent, only one specimen ( $\sigma$ ) with indistinctly defined median subcephalic plate. This plate is limited at its latero-posterior edge by distinct cuticular crescents and is covered with tiny granulation (Fig. 15: *su*). Other specimens without cuticular crescents, but with tiny granulation in the subcephalic area and in the genital region. Rest of venter smooth. The female genital papilla is moderately sized (diameter 11  $\mu$ m in a specimen 255  $\mu$ m long). The male gonophore is located in a small cavity. There are no (pseudo)plates in the genital region.

Dorsal plates and, to lesser degree, lateral sides of the body, with regular internal sculpture ('granulation'), varying from very short and thin epicuticular pillars to larger knobs (Figs 1, 10-14) which are relatively closely placed and uniformly distributed, when compared with other species of *Mopsechiniscus*. The knobs resemble smaller or larger dots arranged in a regular pattern when viewed dorsally (Figs 10, 11), and give the impression of being on the cuticular surface rather than inside it. Such a pattern, limited to small granulated area, occurs also externally in the proximal (basal) part of each leg (Fig. 17: *ga*). The smaller dots roundish in shape, the larger with irregular edges and a roundish spot inside. As a result, the larger dots have the appearance of tiny rings. Some smaller knobs, mainly on lateral sides of the shoulder and terminal plate, but also on legs, often connected by very thin, barely visible strips, thus forming there a mesh-like pattern similar to that found in *Cornechiniscus lobatus* (Ramazzotti, 1943) or *C. schrammi* (Dastych, 1979), for example. The knobs more or less hexagonally arranged, the largest ones (diameter up to 1.8  $\mu$ m; mostly about 1  $\mu$ m) there being on the terminal plate and most widely spaced. Surface between dorsal plates, particularly on lateral sides of body, with granulation similar to that on the plates. Pillars and knobs most closely placed on the head-, shoulder- and lateral edges of paired and terminal plates. Dorsal ornamentation of head plate (faceting) includes two posteriorly rounded, lobe-like and slightly concave areas with larger granules (head shields, *hs*: Figs 10, 12, 14) vertically separated by anteriorly narrowing triangle-like strip of tiny granulation (Figs 10, 14: *arrowhead*). Tiny granulation surrounds head shields (Fig. 1, 10, 14), forming a pattern characteristic for many echiniscids. Neck plate distinctly granulated (Figs 10, 14).

Each side of dorsal trunk plates 1-3 with a small, rather poorly defined lateral plate (platelets 1-3) (Fig. 1: *arrowheads*). Platelet 1 more or less trapezium shaped, without lateral tooth or spine *B*, although poorly separated from shoulder plate, is the most distinct and largest, compared with other platelets (Figs 1; 10, 1: *p1*). The partial separation caused by a narrow cuticular incision, forming a strip of smooth or only lightly granulated cuticle (Figs 10, 12). The incomplete separation is seen in two of four specimens positioned dorso-laterally: in two individuals mounted dorsally, the character could not be observed. Platelets 2 and 3 smaller, with poorly defined edges, of which the anterior one is the most distinct (Figs 1, 11). Platelet 4 could not be made out.

Median plates 1 and 2 relatively large (Figs 1, 10, 13). In three of the four specimens the median plate 2 with more or less distinct transverse cuticular fold or groove of variable length, separating the plate superficially into a larger anterior and smaller posterior area (Figs 1, 11). Median plate 1 (*m1*) triangular, median plates 2 (*m2*) and 3 (*m3*) more or less trapezoid and rhomboid, respectively (Figs 1, 10, 11, 13: *m1-m3*). Plate *m2* with two indistinct small lateral folds. Posterior part of plate *m2* folded slightly over anterior margin of the (segmental) paired plates II and covering more or less the triangular median insertion (Fig. 11: *n*) of the latter plate. Terminal plate short and relatively wide, with two long, almost parallel incisions (notches: Figs 1; 11, 13: *n*). The plate laterally with a wide but flat bulge (Figs 1, 11, 13: *arrow*).





Figs 13-17. *Mopsechiniscus frenoti* sp. n.: **13**- dorsal plates; **14**- fragment of the head and the first trunk segment, dorsally (♀); **15**- ibid., ventrally; **16**- leg IV, dorsally; **17**- leg I, external side view (Fig. 16: holotype. Scale bar 10 µm).

Head segment ventrally with a pair of cephalic papillae (= secondary clavae) (Figs 3, 10: c2). The papillae large and flattened dome-shaped structures (Figs 3, 10, 15), in males slightly larger and more oval than in females; their size 7-12 x 7-9 µm (11 x 7 µm). External and internal cephalic sensory appendages (cirri) absent. Mouth cone distinct, located medially, slightly below the transversal level of the papillae (Fig. 3: arrow).

All trunk cirri long and filamentous. There are two (in one specimen three) pairs of lateral appendages, i.e. A, (C), D and a pair of dorsal appendages *m2d* (Figs 1, 11, 13). Lateral appendages (cirri) A and D present in three specimens, in one (the largest, ♀) an additional pair (cirri C). Length of cirri A 61-155 µm (110 µm), C 130 µm and D 77-147 µm (97 µm). Base of each cirrus wide. Lumen of the cirrus base and its flagellum not sclerotized, forming an almost empty capillary tube. A short sclerotized cuticular unit is visible inside the appendage, well above its base. (This structure has already been reported in *M. imberbis* (Dastych, in print)). Cirri A with bulb-shaped bases (Figs 1, 12). Primary clava (= clava, c1) conical with roundish apex, located in a small protective cavity near base of cirrus A (Figs 10, 12) and directed backwards. The clava 7.5-9 µm long and 5.0-5.5 µm wide at its base (8.0 x 5.5 µm). Cavity, shaped similar to clava, covered with tiny pillars. Dorsal appendages (*m2d*), with markedly wide base, located at posterior edge of median plate 2 (the trunk level C). Posterior margin of vertically

subdivided pseudosegmental plate smooth; without projections on terminal plate (the level E).

Legs median sized, I-III externally with a small, thick and elongate structure, forming a kind of sclerotized cuticular plate at the leg base (Figs 11, 17: *bp*). These basal plates smooth (without pillars) and narrowing posteriorly. Legs I-III below the plate with granular area, the granules resembling those on the dorsum, but smaller (Fig. 17: *ga*). Some granules on legs IV connected by extremely narrow striae. Distal part of each leg, i.e. its foot (= 'tarsus') slightly asymmetrical due to two cuticular structures of unequal size, located on either side of the row of claw (Fig. 16, *arrowhead*). One of the structures, somewhat cushion-shaped and relatively broad, located at the base of its external claw, on internal side of leg (Figs 4-7: *ic*), the other smaller, more conical (cusp-like), located on external side of the leg, also at external claw (Fig. 9: *ec*). Both these 'cushions' with tiny, barely visible granulation. Legs II and III with poorly defined spur slightly above the external cushion. The spur formed as an indistinct, slightly elongated and flattened cuticular elevation. First leg without sensory spine; in one specimen however, a tiny ( $4 \times 2 \mu\text{m}$ ) oval dot in a lateral position (Fig. 17: *arrow*). Leg IV with small dome-shaped sensory papilla of  $3.5\text{--}4.5 \mu\text{m}$  ( $4.5 \mu\text{m}$ ) diameter (Figs 1, 11). Legs IV without spine fringe.

Claws median sized, with their length increasing slightly towards posterior on legs I to III; those of leg IV distinctly longer (in holotype 16 and  $18 \mu\text{m}$  long on leg III and IV, respectively). Claws slender, with moderately defined basal cusp (Figs 4, 5: *bc*). External claws smooth and slightly constricted in the middle, internal claws with a distinct spur at the base (Figs 4-8). Space between spur and base in all internal I-III claws, in exactly lateral view, distinctly oval. This space markedly larger on leg IV (Fig. 7). The spur located further from the basal cusp, than that in *M. imberbis*.

Buccal apparatus large, 30-34 % of body length. Stylets long, one specimen with poorly preserved stylet support. Mouth tube with double cuticular wall encrusted with  $\text{CaCO}_3$  (Fig. 2: *t*), its pharyngeal part simple, not encrusted but strongly sclerotized (Fig. 2: *arrowhead*). Placoids curved and relatively wide. (Buccal apparatus  $88 \mu\text{m}$  long in a  $255 \mu\text{m}$  specimen: the diameter of the pharynx  $28 \mu\text{m}$ , its buccal tube  $67 \mu\text{m}$  long,  $3 \mu\text{m}$  wide in diameter, length of placoids  $14.5 \mu\text{m}$ ).

**DIFFERENTIAL DIAGNOSIS.** The new species can be readily distinguished from the other three congeners through the different pattern of its cuticular sculpturing, the length and shape of the dorsal appendages (*m2d*) on median plate 2 and, to a lesser degree, through a partial division of the latter plate. In *M. frenoti* sp. n., knobs of the cuticular sculpture are much more closely placed, when compared with other taxa of *Mopsechiniscus*, notably *M. tasmanicus*. The appendages *m2d*, while very long and filamentous in *M. frenoti* sp. n., they are short spines or teeth in *M. imberbis* and are absent in *M. granulatus* and *M. tasmanicus*. Furthermore, while in the new species a more or less distinct transversal groove or fold divides median plate 2 in an anterior and posterior part, no such (apparent) separation is found in the remaining taxa of *Mopsechiniscus*. Other characters which separate these species are:

*M. frenoti* sp. n. has no projections (spines) on the pseudosegmental plate (mostly present in *M. imberbis*) and its long lateral projections C (though mostly absent), are formed in *M. imberbis* as short spines. Also, while the external leg spur in *M. imberbis* is formed as a prominent and wide but short conical projection on legs I-III and as

distinct papilla on leg IV, it is in the new species present only on legs II-III, and is barely visible and formed as an indistinct, small cuticular elevation (The structures can be seen only in laterally or latero-dorsally mounted specimens, of which only one was available). Both species differ also through their granulation on the neck plate (which is absent or only slightly developed in *M. imberbis*, but well defined in *M. frenoti* sp. n.) and in the development of platelets. These hardly defined in the new species with *pl* 4 totally absent, while all four platelets are well formed in *M. imberbis*. Furthermore, while the lateral projection (spine) *B*, associated with platelet I, occurs in the latter taxon (Dastyh, in print), it is absent in *M. frenoti* sp. n.

The new species can be easily separated from *M. tasmanicus* through the lack of the lateral appendages *E*, which are very long and strong in this species (see Dastyh & Moscal 1992). In *M. tasmanicus* spurs on internal claws are longer, thinner and directed more towards the claw base than those in *M. frenoti* sp. n. Moreover, in *M. tasmanicus* the apex of the spur reaches almost to the claw base, i.e. the poorly defined basal cusp. In *M. frenoti* sp. n. the space between the spur and basal cusp is also distinctly larger and the spur apex is further from the claw base. (Since *M. tasmanicus* was described from two specimens only and since their legs are strongly retracted in slide preparations, making observation of leg spur impossible, there is no data on its shape and presence. *M. tasmanicus* has, as other *Mopsechiniscus*, two cushion-like structures on the feet, a character not reported in the original description).

*M. frenoti* sp. n. differs from *M. granulosus* through the lack of the projections *psd* on the pseudosegmental plate (usually present in *M. granulosus*), the much poorer defined platelets (particularly the platelet IV, which is actually lacking in *M. frenoti* sp. n.), the barely visible rudimentary spur on legs II and III (present as distinct papillae in *M. granulosus*) and the shape and location of spurs on internal claws. In the new species these are located more distally, compared with *M. granulosus*, so that space between claw spur and basal cusp in *M. frenoti* sp. n. is also larger. By and large, a comparison with *M. granulosus* is problematical, as the species description is rather poor (see Mihelčič 1967, 1971) and thus badly needs to be revised.

*M. frenoti* sp. n. can be separated from the Venezuelan specimens (probably undescribed taxon) described as *M. imberbis* by Grigarick *et al.* (1983) by the following features. While lateral appendages *A*, (*C*), *D* are long, filamentous setae, they are much shorter and spine-like in the Venezuelan material. In the latter particularly the spines *C* and *D* are distinctly shorter (ca. 10-15 µm) and *C* is sometimes absent. Moreover, both cirri *C* and *D* may also be reduced to wide and very short conical processes. Furthermore, specimens from Venezuela have a relatively distinct, papilla-shaped spur on legs II and III, a well formed platelet IV, relatively shorter claws and more distinct basal leg plates. Their claw spurs are also located nearer the claw base, than those of *M. frenoti* sp. n.

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## Zusammenfassung

Eine neue Tardigradenart, *Mopsechiniscus frenoti* sp. n., wird aus den subantarktischen Moosen (Îles Crozet: Île Possession) beschrieben. Die neue Art unterscheidet sich von allen anderen Taxa dieser Gattung durch regelmäßig angeordnete, nicht weit voneinander entfernte kutikuläre Erhebungen ("Granulen") der dorsalen Skulptur und das Vorhandensein von langen, flexiblen Cirri (*m2d*) auf der zweiten Schaltplatte.

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