



Halechiniscus chafarinensis n. sp. (Halechiniscidae), a new marine Tardigrada from the Alboran Sea (SW Mediterranean Sea)

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Abstract: *Halechiniscus chafarinensis* n. sp., from Chafarinas Islands (SE Alboran Sea, N. Africa), shares plesiomorphic characteristics with other species of *Halechiniscus* (*H. tuleari*, *H. paratuleari* and *H. macrocephalus*), namely the division of the head in two lobes, the presence of large cirrophori supporting cephalic cirri, and evident lateral processes. The former character may be also an evidence of relationship between Halechiniscidae and Stygarctidae.

Résumé : *Halechiniscus chafarinensis* n. sp., des Iles Chafarinas (SE Mer d'Alboran, N. Afrique), partage des caractères plésiomorphes avec d'autres espèces du genre *Halechiniscus* (*H. tuleari*, *H. paratuleari* et *H. macrocephalus*), comme la division de la tête en deux lobes, la présence de larges cirrophores portant les cirres céphaliques et les expansions latérales bien visibles. Le premier de ces caractères peut être aussi considéré comme une preuve de la relation entre les familles des Halechiniscidae et des Stygarctidae.

Keywords: Marine Tardigrada, Halechiniscidae, *Halechiniscus chafarinensis*, Stygarctidae, Mediterranean Sea.

Introduction

Halechiniscidae is the most diverse family of the Arthrotardigrada, including seven subfamilies and 28 genera. Only half of the Halechiniscidae genera are known in the Mediterranean Sea. Nevertheless, the genus *Halechiniscus* shows its highest diversity in this Sea, where all known species of the genus have been recorded, mainly from the Italian coasts.

Adriatic, Tyrrhenian and Ionian coasts around Italy are the best studied for Mediterranean Tardigrada, while Oriental and south-western basins are poorly studied. Knowledge of Tardigrada from the Alboran Sea (SW Mediterranean) started with a previous work by Villora-Moreno & De Zio Grimaldi (in press). In that work 15 species of marine tardigrades from Chafarinas Islands (SE

Alboran Sea) are listed, including three species of the genus *Halechiniscus*: *H. remanei* Schulz, 1955, *H. perfectus* Schulz, 1955, and *H. greveni* Renaud-Mornat & Deroux, 1976. In this paper we describe a new species of *Halechiniscus* recorded in the Chafarinas Archipelago.

Materials and Methods

Meiobenthos samples were collected by means of SCUBA diving during the CHAFARINAS'91 field survey in the Chafarinas Archipelago (south-western Mediterranean, North Africa). *Halechiniscus chafarinensis* n. sp. was collected in coarse mineral (basaltic) sediment from a shallow sublittoral pool between *Posidonia* meadows. The sampling station was located south of the island Isabel II (sta. IS11). General environmental and biological (meiofauna) characteristics of the study area were described by Villora-Moreno (1993).

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Samples were treated with 7.5% $MgCl_2$ as a narcotic agent and fixed with 10% buffered formaldehyde. Tardigrades were mounted in glycerine, using a coverslip with supports to prevent body deformations. All drawings were prepared using a camera lucida on a Wild microscope. The type material has been deposited in the Museo de Ciencias Naturales de Madrid, Spain (MCNM).

SYSTEMATIC RESULTS

Family Halechiniscidae Thulin, 1928
 Subfamily Halechiniscinae (Thulin, 1928)
 Genus *Halechiniscus* Richters, 1908
Halechiniscus chafarinensis n. sp.
 (Figs. 1-2-3)

Type material. Holotype: MCNM, female 145 μm , from Isabel II Island (sta. IS11, - 4.5 m depth), Chafarinas Archipelago, SE Alboran Sea, collected by S. Villora-Moreno (10 August 1991). No allotype or paratype.

Diagnosis. *Halechiniscus* with cephalic region divided in two lobes: a dorsal one with its central part protruding dorsally to support the strong medial cirrus and the lateral sides expanding with large cirrophori bearing lateral cirri and primary clavae, and a ventral one bearing the external ventral cirri and the internal dorsal ones.

Ventral mouth opening in the middle of an elevated square-like area. Kidney-shaped sensory areas (may be secondary clavae) surrounding the mouth.

Nine evident latero-dorsal conical expansions, six smaller (the first, second, fourth, fifth, seventh and eighth) and three larger (the third, sixth and ninth) on both body sides. The third and sixth expansions on the first and second leg, the ninth before the cirrus E.

Legs and claws as usual in *Halechiniscus*.

Description. Cephalic region divided in two lobes, separated by a furrow, bearing the different cephalic sense organs.

Dorsal lobe with an undulated frontal edge with a medial crescent expansion from which the medial cirrus arises with a strong conical cirrophorus (Fig. 1). Swollen and large cirrophori at the lateral sides of the lobe, with cirri A and primary clavae. The latter are ventral to the cirri.

Ventral lobe, with the frontal ridge protruding anteriorly, bearing dorsally the internal cirri and ventrally the external ones. The latter are located at the anterior angles of the square-like area in the middle of which there is the mouth opening (Fig. 2). Cephalic cirri organized all according to the same pattern: cylindrical scapus with cup-like ending, followed by a flagellum completely sheathed with the exception of the small hair-like distal portion.

Medial cirrus 34.5 μm long, on a stout cirrophorus (9 μm) and consisting of a scapus 16.4 μm long and flagellum 18.1 μm long (4.5 μm unsheathed).

External cirrus 20.9 μm long with 10 μm scapus and 10.9 μm flagellum (4.5 μm unsheathed) (Fig. 3 C).

Internal cirrus 21.8 μm long with 9.1 μm scapus and 12.7 μm flagellum (3.6 μm unsheathed) (Fig. 3 B).

Primary clava tubular (25.5 μm long) with uniform diameter along all its length and a terminal opening (Fig. 3 A).

Cirrus A 25.4 μm long, with 9.1 μm scapus and 16.3 μm flagellum (2.7 μm unsheathed), dorsal to the primary clava and arising at the van der Land's organ level.

Two kidney-like sensory areas (secondary clavae?) at each side of the mouth opening.

Two globular bodies (4.5 μm diameter), without evident cells, are present inside the head at the base of the medial cirrus. They look like the head unicellular glands of *Renaudarctus psammocryptus* Kristensen and Higgins, 1984, but no hypothesis about their true nature and function can be put forth.

Mouth opening surrounded by a strong and evident ring. Pharyngeal apparatus consisting of a curved pharyngeal tube (30 μm long), two stylets (29.1 μm) with their supports, and the spherical pharyngeal bulb (11 x 13 μm). The latter followed by the mesenteron with three large pairs of lateral sacs and ending in the ventral anus.

Two large elongated pluricellular glands, at each side of the pharyngeal bulb, but without evident connection with it.

Cirrus E 43.7 μm long with 7.3 μm stout base followed by an accordion-like portion (14.5 μm) and a flagellum 21.9 μm long (5.5 μm unsheathed) (Fig. 3 H).

Tibial sense organs present on all the legs and consisting of two segments. The first sense organ is 9.1 μm long (5.5 μm scapus plus 3.6 μm flagellum), the second 11.7 μm (7.2 μm plus 4.5 μm), and the third 13.6 μm (9.1 μm plus 4.5 μm). The fourth leg sense organ, 11 μm long, is papillar (6 μm) with a thin terminal tube (5 μm).

Nine evident dorsal trunk processes of different length, three larger (the third, sixth and ninth) and six smaller (the first, second, fourth, fifth, seventh and eighth), are present on both the body sides. The three largest are conical with the distal part backward directed. The third is located on the first leg, the sixth on the second leg and the ninth before the cirrus E. The six smaller alternate with the largest ones.

Body cuticle smooth in both the ventral and dorsal regions with the exception of the caudal dorsal area which is delimited by an undulated cuticular cordon-like thickening. This area includes the cirri E bases.

Legs, toes and claws as usual in *Halechiniscus*: telescopic legs, wrinkled fingers with spiral-like small folds with simple external claws and the internal claws with a small dorsal spur. Evident claw gland inside the base of each leg.

The dorsal ovary extends from the pharyngeal bulb level to the caudal region where the largest oocytes can be observed. The one oviduct surrounds the rectum and opens

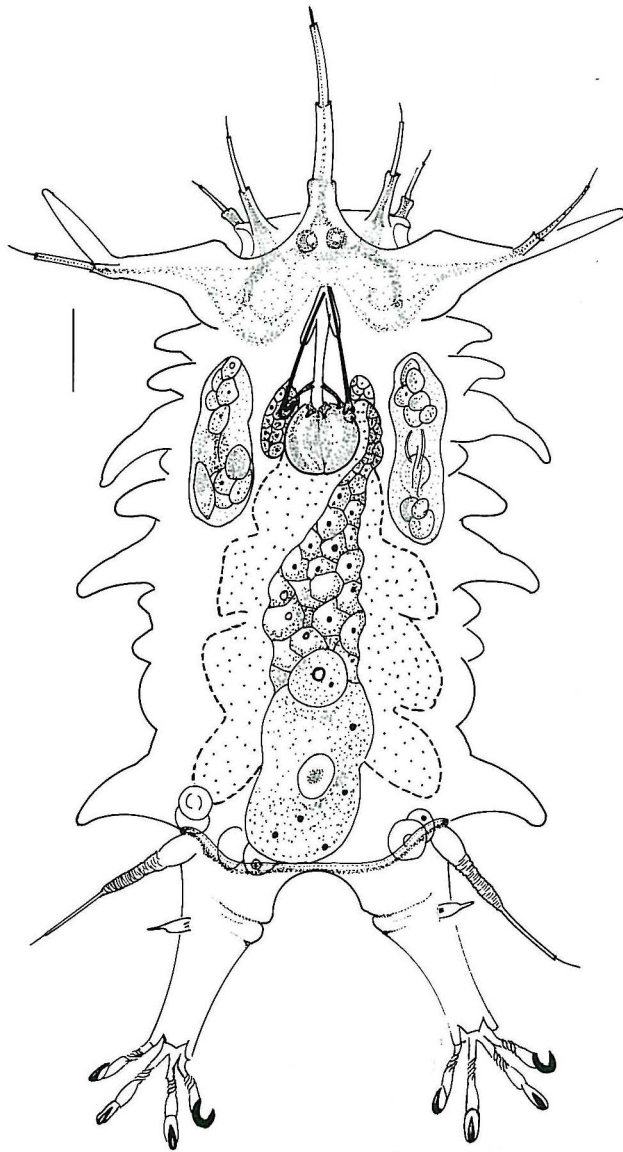


Figure 1. *Halechiniscus chafarinensis* n. sp., holotype female in dorsal view. Scale bar: 20 μ m.

Figure 1. *Halechiniscus chafarinensis* n. sp., holotype femelle, vue dorsale. Echelle = 20 μ m.

out ventrally an the gonopore. The rosette-like female gonopore is surrounded by a hexagonal cuticular fold, and flanked by the openings of the long and sinuous lateral ducts of the seminal receptacles which are located near the fourth leg bases. Three pointed anus scar 20 μ m from the gonopore.

The posterior ridge of the body makes a dorsal fold which overlaps the basal parts of both the cirri E and the coxal portions of the fourth legs.

Numerous isolated or grouped coelomocytes are scattered inside the general body cavity. Furthermore

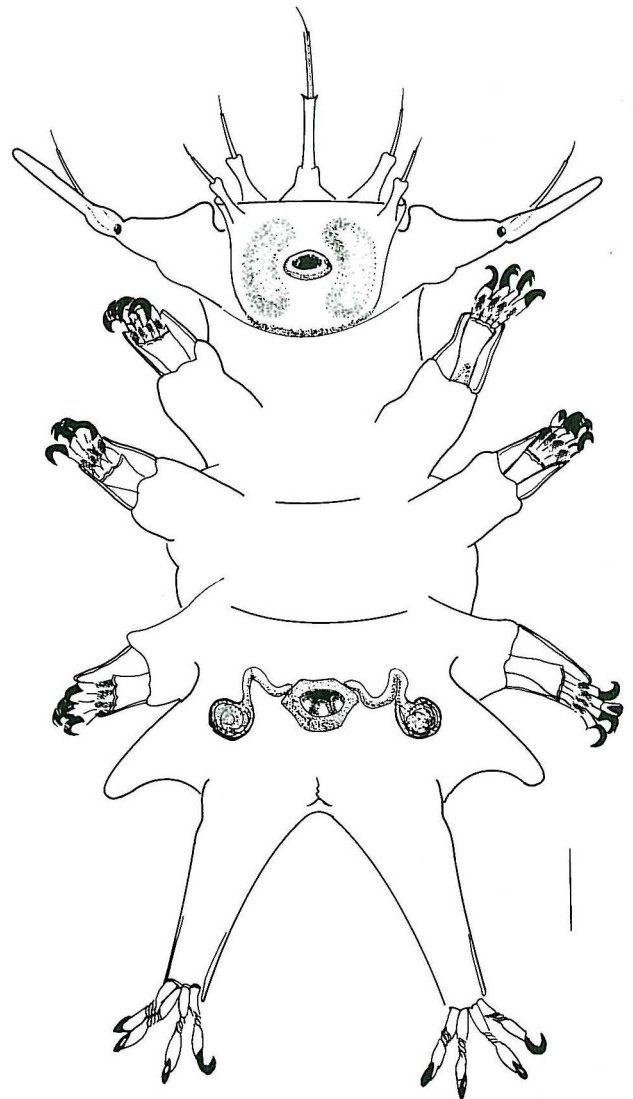


Figure 2. *Halechiniscus chafarinensis* n. sp., holotype female in ventral view. Scale bar: 20 μ m.

Figure 2. *Halechiniscus chafarinensis* n. sp., holotype femelle, vue ventrale. Echelle = 20 μ m.

several roundish segmental glands, approximately at each leg level, are present in the body cavity. No paratypes.

Ecology and geographical distribution. This species has been identified in the interstitial environment of basaltic coarse sand, from a pool between *Posidonia* meadows, at -4.5 m depth. *Halechiniscus chafarinensis* n. sp. was recorded from a sole sampling station in the Chafarinas Island (SE Alboran Sea).

Discussion

H. chafarinensis is undoubtedly a very interesting new Halechiniscinae species which, from a phylogenetical point

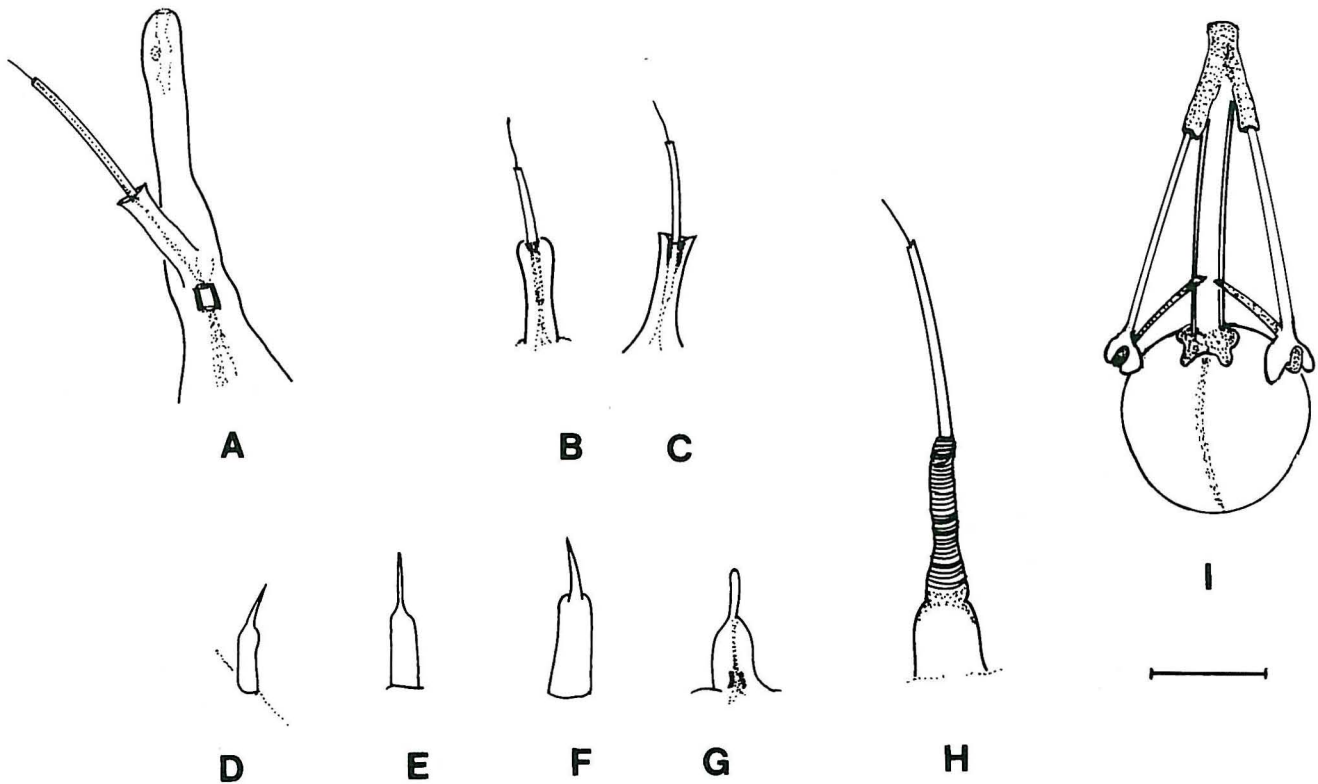


Figure 3. *Halechiniscus chafarinensis* n. sp., holotype female, A: Cirrus A and primary clava; B: internal cirrus; C: external cirrus; D, E, F, G: 1st, 2nd, 3rd, 4th sense organs; H: Cirrus E; I: pharyngeal apparatus. Scale bar: 10 μ m.

Figure 3. *Halechiniscus chafarinensis* n. sp., holotype femelle, A : Cirre A et clava primaire, B : cirre interne ; C : cirre externe ; D, E, F, G : organes sensoriels des 1^{re}, 2^e, 3^e, 4^e pattes ; H : Cirre E ; I : appareil pharyngien. Echelle = 10 μ m.

of view, shares some important features with some other *Halechiniscus* species, such as *H. macrocephalus*, *H. tuleari* and *H. paratuleari*: they have large cephalic cirrophori supporting median and lateral cirri and a more or less evident division of the head in two lobes, on which the different cephalic sense organs are distributed. Nevertheless the cephalic sense organs distribution in *H. chafarinensis* is peculiar because only the lateral cirri, primary clavae and medial cirrus are located on the cephalic dorsal lobe, whereas both the internal and external cirri arise from the ventral lobe. The same pattern of sensory organs distribution can be observed in the Echiniscoidea, Oreellidae and Echiniscidae, where it is considered to be a plesiomorphic character (Kristensen & Higgins, 1987). Taking into account the characteristics of the cephalic region of *H. chafarinensis*, the differences between the *H. tuleari*, *H. paratuleari* and *H. macrocephalus* group and the other *Halechiniscus* species such as *H. gutteli* Richters, 1908, become less evident because of the intermediate position of the new species between the two extreme clusters.

Furthermore, this species provides new evidence for a relationship between Halechiniscidae and Stygarctidae: the head being more or less deeply divided in two lobes (dorsal and ventral) bearing the different cephalic sense organs is frequent in the Stygarctidae family, mainly in the genus *Parastygarctus*. The head divided in lobes in some species of the subfamily Halechiniscinae could be therefore considered plesiomorphic, whereas the presence of the external and internal cirri on the ventral lobe is apomorphic if compared with the distribution of the sense organs in the Stygarctidae.

Another element of relationship with the Stygarctidae could be the presence of the large lateral processes that in *H. chafarinensis* are stout and quite different from the processes present in the other species of the genus.

Interesting is the presence in *H. chafarinensis* of the peribuccal kidney-shaped sensory areas. These features are frequent in the Halechiniscidae, even if sometimes reported in the literature only with drawings, such as in the Halechiniscinae (Renaud-Mornant, 1979, Kristensen & Higgins, 1989), Euclavarctinae (Renaud-Mornant, 1983),

Tanarctinae, Florarctinae (Mc Kirdy *et al.*, 1976, Renaud-Mornant, 1987 b, 1989 a), Orzeliscinae (Du Bois-Reimond Marcus, 1952, Renaud-Mornant, 1989 b). These sensory areas have been considered as modified secondary clavae (Kristensen & Higgins, 1989). In fact when there are large club-shaped secondary clavae, as in Styraconyxinae or flattened lobes as in Coronarctidae, these areas are absent. To date it is difficult to establish if they represent a plesiomorphic or an apomorphic characteristic of the family Halechiniscidae, but taking into account the presence of evident secondary clavae in the Stygarctidae and Coronarctidae and the morphology of these sensory organs in all the Halechiniscidae, we could consider the reduction of the secondary clavae as an apomorphy.

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