

A hydrothermal vent mite (Halacaridae, Acari) with a new *Corynophrya* species (Suctorina, Ciliophora), description of the suctorian and its distribution on the halacarid mite

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Abstract

Copidognathus nautiliei Bartsch, 1997, from a hydrothermal vent field of the Mid-Atlantic Ridge at about 13°N, 45°W and 4090 m depth, was infested with the suctorian *Corynophrya abyssalis* n. sp., with up to 58 epizoans per mite. The new suctorian has a sacciform body with seven longitudinal ribs, a compact macronucleus and up to 40 non-retractile tentacles. The budding is exogenous. The systematic position of the new species and the genus *Corynophrya* is discussed, as well as infestation rates and sites of suctorians on their halacarid hosts.

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Keywords: Abyssal; Ashadze; halacarid mite; Mid-atlantic ridge; new species; Suctorina

Introduction

Suctorians are spread in marine and fresh water, they inhabit both anorganic and organic material, plants and animals. Inhabitants of animals may be commensals, ecto- or endoparasites. Amongst others suctorians colonize halacarid mites.

The first halacarid mite described, *Thalassarachna basteri* (Johnston, 1836), also was the first mentioned halacarid host of a suctorian. Gosse (1855) found two epizoans on this mite (which erroneously was identified as *Halacarus ctenopus* Gosse, 1855 – cf. Bartsch 2001), a *Vorticella* sp. (Peritrichia, Ciliophora) and several *Acineta* sp. (Suctorina) attached to the idiosoma and legs, respectively. The suctorians, described and illus-

trated by Gosse, 1855: 306, Plate 8, Fig. 6), had a length of 1/390th of an inch (about 65 µm), a short stalk and a slightly longer distinctly annulated and apically truncate body with two tentacle fascicles. These suctorians most likely were representatives of a species nowadays known under the name *Acineta sulcata* Dons, 1927.

Since those days several more records of suctorians on halacarid mites have been published (Dovgal et al. 2008), but still the number of species is limited. Most records are from shallow waters. A deep-sea record of an epibiont on Halacaridae is from the Mid-Atlantic Ridge, Snake Pit, 3500 m (Bartsch 1994). The suctorian species described in this paper is from a more southern site.

Material and methods

The halacarid mites with suctorians are from the Mid-Atlantic Ridge, from the recently discovered station

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Ashadze, collected during the French-Russian cruise Serpentine and taken with the submersible Victor 6000 which was operated from the RV Pourquoi pas? The cruise was organized by IFREMER (Institut Français de Recherche pour l'Exploitation de la Mer), chief scientist was Yves Fouquet. More information on the cruise gives the web page <http://www.ifremer.fr/biocean>. The biological samples were sorted at the IFREMER. For microscopical studies of the suctorians, the mites, stored in ethanol, were transferred into glycerine. Terminology and systematics in the descriptive part follow Dovgal (2002).

Host of the suctorians is the halacarid *Copidognathus nautili* Bartsch, 1997, a species first described from the Mid-Atlantic Ridge, site Irina 2 (15°N, 45°W, 3050 m) (Bartsch 1997). It was the only mite species in the samples from station Ashadze. The idiosomal length of the adult mites is within a range of 395–450 µm.

Results

Corynophrya abyssalis n. sp.

Diagnosis: Body sacciform, rounded in cross-section but with seven longitudinal ribs. Body length 37–54 µm. Apical surface with up to 40 non-retractile tentacles. Macronucleus compact, situated centrally, rounded to slightly ovate. Stalk length 18–25 µm, slightly widened towards cell body. Budding exogenous.

Type locality: Mid-Atlantic Ridge, station Ashadze, 12°58.3521N, 44°51.7768W, 4087 m depth, 13 March 2007, Cruise Serpentine, Dive 312–3, slurp gun bottle No 4.

Type host: *Copidognathus nautili* Bartsch, 1997 (Halacaridae).

Type material: Holo- and several paratypes on a slide, still attached to the female halacarid mite and mounted in glycerine. Holotype on second segment of first right leg (cf. Figs. 1, 2). Muséum National d'Histoire Naturelle, Paris, Section Protistes (registration number MNHN ZS 82).

Additional material (stored in ethanol): Suctorians attached to a female and male of *Copidognathus nautili*, Mid-Atlantic Ridge, station Ashadze, 12°58.3455N, 44°51.7879W, 4088 m, 13 March 2007, Cruise Serpentine, Dive 312–3, little collection box 3. Muséum National d'Histoire Naturelle, Paris, Section Protistes (registration number MNHN ZS 83). Suctorians attached to a male of *Copidognathus nautili*, collecting data as above, Zoological Museum, University Hamburg. Suctorians attached to a male of *Copidognathus nautili*, Mid-Atlantic Ridge, station Ashadze, 12°58.3342N, 44°51.7913W, 4088 m, 15 March 2007, Cruise Serpentine, Dive 313–4, blade corer 7. Muséum

National d'Histoire Naturelle, Paris, Section Protistes (registration number MNHN ZS 84).

Etymology: The name is derived from *abyssos* (Greek), bottomless and *abyssal*, the bottomless zone, in which the species live.

Description: Body more or less inverted sacciform, from distinctly to slightly narrowed towards base (Figs. 1, 2, 3A), almost rounded in cross-section but with seven very marked longitudinal ribs (Fig. 3A, B). Length of body 37–54 µm, width 25–30 µm. Body surface with very faint annulated striation. About 40 non-retractile tentacles arranged in single apical group, several arising from near-basis of calotte-shaped protruding. Tentacles about 14–19 µm in length and 1 µm in diameter, each ending with small blunt knob. Macronucleus compact, centrally located, rounded to slightly ovate in outline, dimensions 9 × 10 µm to 15 × 8 µm. Number of tentacles reduced to about 30 in individuals with tomit, these tentacles short, 10 µm in length.

Stalk 18–25 µm in length, slightly more half the body length. Calyciform widened toward body and forming an epicone, 7–8 µm in diameter (Fig. 3A, ec). Stalk equal in diameter (4 µm) for most of its length; not markedly narrowed towards its base.

In a few specimens body contracted, almost spherical, length and diameter 28–32 µm. Ribs present. Number and size of tentacles reduced, tentacles concentrated on small apical area. These specimens assumedly moribund.

Reproduction: Asexual reproduction by exogenous budding (Fig. 5). Apical cone of tomit smooth (Fig. 5A), surface of remainder with distinct, annulated striation (Figs. 4, 5C); no cilia recognizable. Tomit studied with eight maternal tentacles, these wider but shorter than in trophont, 8–10 µm in length and almost 2 µm in diameter, and situated within anterior striated part of body. Swarmer vermiform, spindle-shaped (Fig. 3C), dimension 62 × 17 µm. Surface annulated, uneven, without cilia. Macronucleus rounded, 7 µm in diameter.

Differential diagnosis: The new suctorian species has no lorica, is rounded in cross-section, all tentacles are similar-sized and restricted to an apical calotte, and the macronucleus is compact and rounded, accordingly it was attributed to the mainly marine genus *Corynophrya*, which was erected by Kahl (1934).

Corynophrya symbiotica Jankowski, 1981 (Fig. 6), an epizoan on arctic polychaetes of the family Aphroditidae, and *C. abyssalis* both have a sacciform, slightly irregularly shaped body with marked longitudinal ribs and their tentacles are situated on an apical calotte. The two species can be discriminated on the basis of (1) length of the body and stalk, 37–54 µm and 18–25 µm, respectively, in *C. abyssalis* but 80–105 µm and 90 µm in *C. symbiotica*, (2) the epicone, present in *C. abyssalis* but absent in *C. symbiotica*, (3) the tentacles, non-retractile and about one-third of the



Fig. 1. Ventral view of anterior part of *Copidognathus nautiliei* with *Corynophrya abyssalis* n. sp., holotype marked with an asterisk. (Scale bar: 100 μ m)

body length in *C. abyssalis* versus retractile and less than one-fifth of the body of *C. symbiotica*, and (4) the host, *C. abyssalis* was found on halacarid mites, *C. symbiotica* on polychaetes.

Suctorians mentioned by Bartsch (1994) from halacarid mites of a nearby hydrothermal vent area (Mid-Atlantic Ridge, 23°23'N, 44°56'W, 3500 m) have similar conspicuous longitudinal ribs but differ from *C. abyssalis* by the larger size (body length 60–70, width 25–35 μ m).

Infestation rate and location: In the *Copidognathus nautiliei* at hand (Table 1) 10 out of the 25 individuals, or 40% of the mites, were infested with *Corynophrya*

abyssalis. In all, 176 suctorians were found; included are those which had lost the lorica but were represented by a stalk (11 stalks), excluded are two swarmer stages. The rate of infestation varied from 1–58 epizoans per mite. Most suctorians (60% of all) were fixed to the halacarid idiosoma, especially to the marginal parts (Fig. 1), somewhat less to the venter (Table 2), no suctorians were found on the dorsum. Both the gnathosomal base and the palps held suctorians, mostly on the ventral flank, rarely on the dorsal side. Suctorians (31%) were also found on the four pairs of legs, attached to one or more of the six leg segments; the highest numbers were on segments 5 (tibiae) and 3 (telofemora).

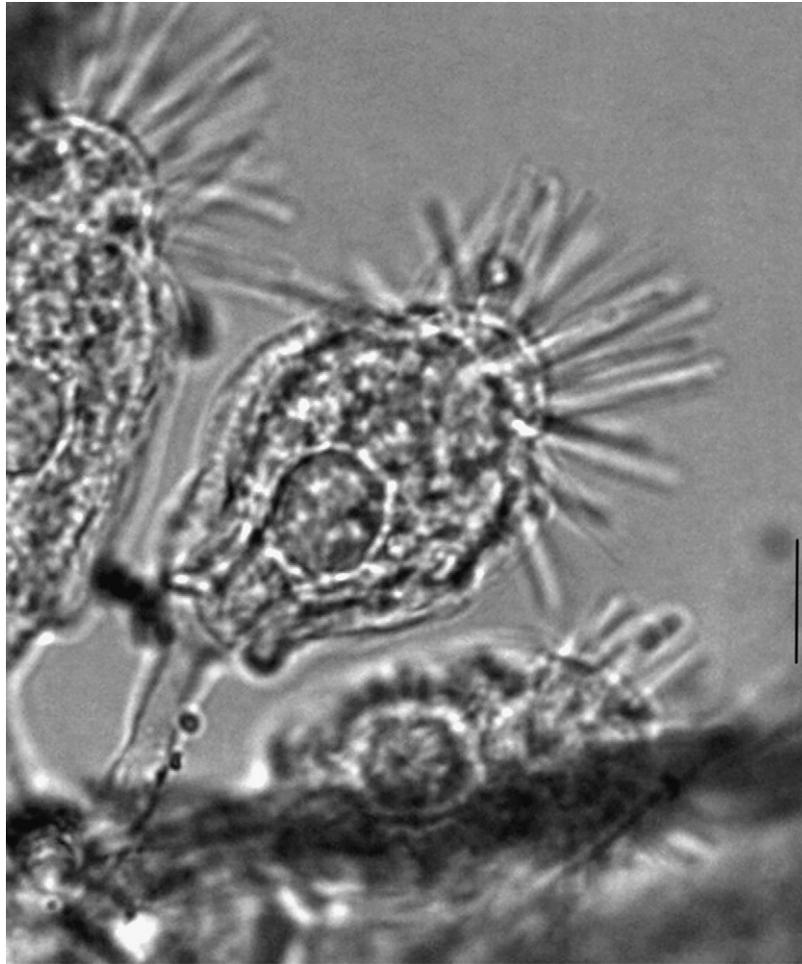


Fig. 2. Photomicrography of holotype *Corynophrya abyssalis* n. sp. (Scale bar: 10 μ m)

Discussion

Remarks on the genus *Corynophrya* and its position

The genus *Corynophrya* now includes seven species, the type species *Corynophrya lyngbyi* (Ehrenberg, 1834), *C. abyssalis*, *C. columbiae* (Wailes, 1943), *C. conipes* (Mereschkowsky, 1877), *C. francottei* (Sand, 1895), *C. macropus* (Meunier, 1910), and *C. symbiotica*. According to Jankowski (2007) *Thaumatophrya troid* (Claparède and Lachmann, 1859) is another possible representative of this genus. The recently described *C. anisostyla* Fernandez-Leboranz and Gomez del Arco, 1996 has been transferred to *Paracineta* Collin, 1912 (Dovgal 2002).

Corynophrya was erected and diagnosed by Kahl (1934) and placed into the family Discophryidae Collin, 1912, a family characterized by internal budding, absence of a theca and similar-sized tentacles (Kahl 1934). At that time two *Corynophrya* species were said to have internal swimmers, the type species *Corynophrya lyngbyi* (Ehrenberg, 1834) and *C. interrupta* (Schröder, 1907). In the meantime, the latter species has been transferred to the

genus *Pelagacineta* Jankowski, 1978 (Jankowski 1978). Claparède and Lachmann (1859: 130-131, Plate I, Fig. 9) presented a description and an illustration of the reproduction of *C. lyngbyi*, but according to Collin (1912: 372), Claparède and Lachmann observed an infestation with a parasitic suctorian similar to *Endosphaera* Engelmann, 1876. The present authors agree in that the figure presented in Claparède and Lachmann (1859) shows parasites rather than swimmers of *Corynophrya*. In most of the following diagnoses of *Corynophrya*, endogenous budding was mentioned as the mode of reproduction (Curds 1987; Dovgal 2002), though in general neither the species' reproduction nor their swimmers were known. By contrast, Jankowski (1981) postulates exogenous reproduction, and this is actually the mode in *C. abyssalis*. As *Corynophrya* includes exogemmin suctorians, the genus, as well as the family Corynophryidae Jankowski, 1981, should be removed from the order Acinetida Raabe, 1964. *Corynophrya* seems to be most closely related to representatives of the family Dentacinetidae Batisse, 1992, order Spelaeophryida Jankowski, 1978.

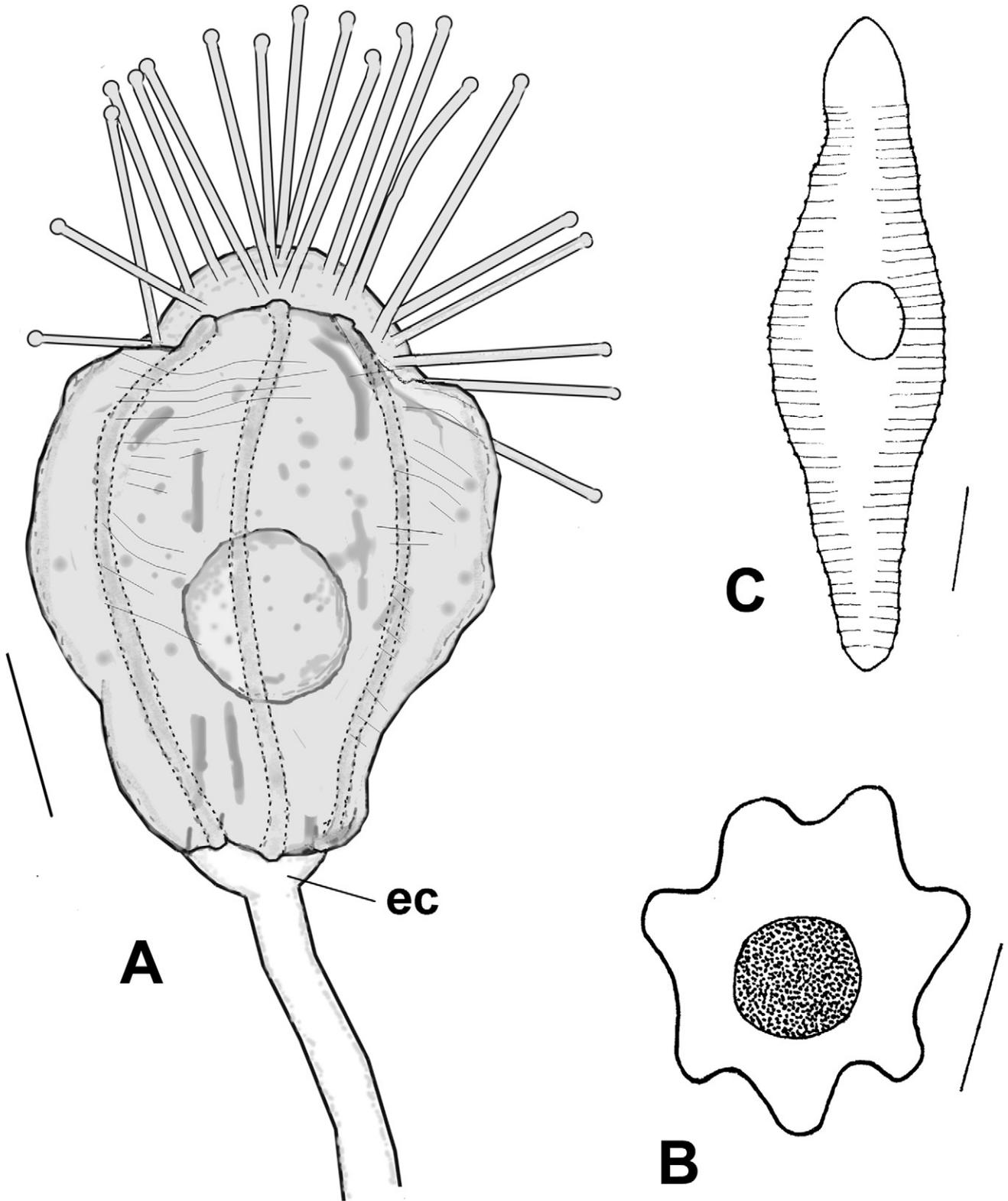


Fig. 3. *Corynophrya abyssalis* n. sp. **A.** Side view (tentacles of opposite side omitted). **B.** Optical cross section at level of macronucleus, showing the cortical ribs. **C.** Swarmer. ec, epicone. (Scale bar: 10 μ m)

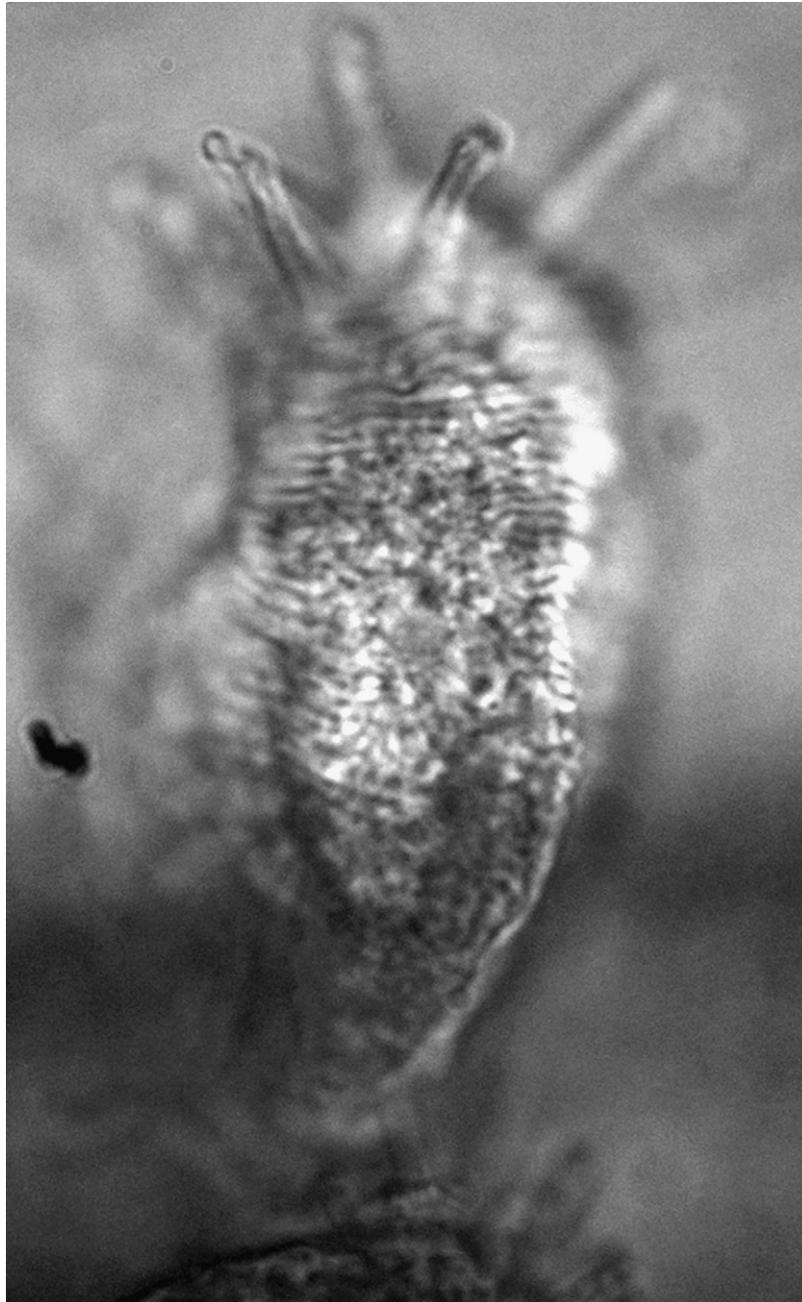


Fig. 4. Tomit of *Corynophrya abyssalis* n. sp. (showing the striation).

Halacarid mites and their suctorian epizoans

Suctorians are common on marine and freshwater halacarid mites. The halacarid genera most often mentioned as hosts of protozoans are *Copidognathus* and *Halacarellus*, other genera known to be infested are *Actacarus*, *Caspihalacarus*, and *Thalassarachna* (Dovgal et al. 2008). Most records are from psamphilous shallow water species belonging to the genera *Halacarellus*, *Copidognathus* and *Actacarus*, but

epibiotic living shallow water and deep-sea halacarids (genera *Copidognathus*, *Halacarellus*, and *Thalassarachna*) are inhabited, too. The highest rate of fouling was found in a population of *Halacarellus discretus* Bartsch, 1998, collected in shallow water sandy deposits of a recreation area near Odessa (Ukraine, Black Sea); of 20 adults studied all were infested, with 8–62 suctorians (*Thecacineta* sp.) per mite (Bartsch 1998). The suctorians are assumedly conspecific with *Thecacineta calix* (Schröder, 1907). The intensity and rate of infestation is

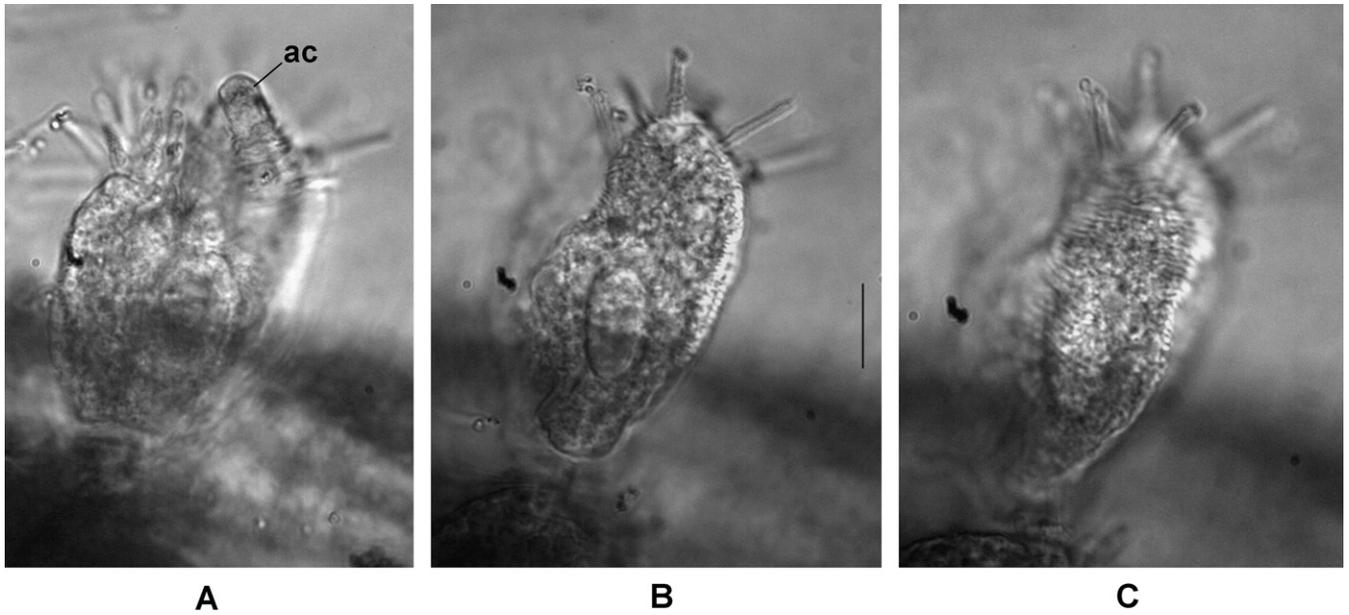


Fig. 5. Exogenous budding in *Corynophrya abyssalis* n. sp. photographed at three optical levels. **A.** Trophont in the foreground, tomit in the background. **B.** Tomit in the foreground, outline of the trophont in the background. **C.** Tomit, focussed on its surface. ac, apical cone of tomit. (Scale bar: 10 μ m)

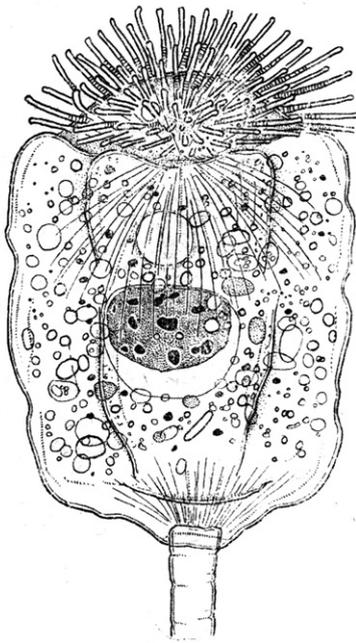


Fig. 6. *Corynophrya symbiotica* (after Jankowski 1981). Body length 80–105 μ m.

distinctly higher than that found on congeners from other Black Sea coastlines (Bartsch 1998), as well as from other seas. A rather high organic pollution certainly favoured a rapid growth and reproduction of the suctorians on *H. discretus*. Ten out of 25 *Copidognathus nautilei* from the Mid-Atlantic Ridge were infested, protonymphs as well as adults. Included in

the mite numbers are several moribund individuals which held no *Corynophrya*; these mites may have lost their epizoans, and accordingly one may expect an even higher infestation rate.

Most *Corynophrya abyssalis* were fixed to the marginal parts of the idiosoma of *Copidognathus nautilei*. A similar concentration of suctorians on the margins of a halacarid idiosoma was illustrated by Dovgal et al. (2008: Fig. 11) and mentioned by Bartsch (1998). *Copidognathus nautilei* had no suctorians on the dorsal but several on the ventral flank of the idiosoma. In other halacarid mites the opposite was found. Abé (1997) presented a picture of an *Actacarus octosetus* Abé, 1997 with three suctorians (*Thecacineta calix*) on the dorsum (Abé 1997: Fig. 5G), and in a *Halacarellus discretus* population from the Black Sea most suctorians were fixed laterally and dorsally to the idiosoma, rarely ventrally (Bartsch 1998).

Individuals of *Corynophrya abyssalis* were present on all leg segments of *Copidognathus nautilei*, from the trochanters to the tarsi. By contrast, a *Halacarellus discretus* population from the Black Sea, densely infested, carried suctorians on the basal but not on the distal segments. *Halacarellus discretus* is psammobiont, whereas *Copidognathus nautilei* is expected to live amongst the surface ooze or in a stable system of crevices and microcavernes. The life style of the mite, psammobiont or epibiont, amongst the interstia of sandy deposits or on the surface of a substratum, is expected to influence the site of a successful settlement of suctorians. Similarly, Olafsdottir and Svavarsson (2002) discussed the behaviour of isopods, burrowing versus limited burrowing, and their infestation with

Table 1. Collecting data and number of halacarids and suctorians studied (F, female; M, male; PN, protonymph)

Dive	Equipment and number	Latitude (N)	Longitude (W)	Depth (m)	Number of mites	Infested mites	Suctorina per mite
312–3	slurp gun bottle 4	12°58.3521	44°51.7768	4087	1F	1F	57
312–3	slurp gun bottle 4	12°58.3435	44°51.7945	4090	2F	0	0
312–3	little collection box 3	12°58.3455	44°51.7879	4088	1F,3M,3PN	1F,3M,1PN	7–31
313–4	slurp gun bottle 4	12°58.3348	44°51.7911	4089	2F	0	0
313–4	slurp gun bottle 5	12°58.3348	44°51.7912	4088	1F,1M	1F	1
313–4	blade corer 7	12°58.3342	44°51.7913	4088	3F,8M	1F,2M	1–26

Table 2. Infestation sites and number of *Corynophrya abyssalis* sp. n. (n = 176) on *Copidognathus nautili*

Part of halacarid body	Number of suctorians	%
Idiosoma	106	60.2
marginal	57	
dorsal	0	
ventral	49	
Gnathosoma	15	8.5
Legs	55	31.3
segment 1	1	
segment 2	10	
segment 3	17	
segment 4	4	
segment 5	18	
segment 6	5	

suctorians. The difference in numbers of suctorians per halacarid leg segment may be due to the size of the segments. The telofemora and tibiae, the segments with a high number of epizoans, have a larger surface than the other segments.

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