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Article in *Polar Biology* · April 2000

DOI: 10.1007/s003000050443

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Two new species of *Herpyllobius* Steenstrup & Lütken, 1861 and a new record of *Herpyllobius antarcticus* Vanhöffen, 1913 (parasitic Copepoda) from the Weddell Sea, Antarctica

Accepted: 24 October 1999

Abstract Thirteen species of the genus *Herpyllobius* Steenstrup & Lütken, 1861 are known to date. In this paper two new species are described as *Herpyllobius polarsterni*, and *H. stocki*. A comparison with congeneric species is made. A new find of *H. antarcticus* is recorded, and the description of Vanhöffen is confirmed. Including the present record, 15 species of *Herpyllobius* are now known, of which 7 have been reported from the southern hemisphere.

Introduction

Herpyllobius Steenstrup & Lütken, 1861 is one of the three genera that are presently recognised within the Herpyllobiidae Hansen 1892, a family of copepods parasitising only polynoid polychaetes (Lützen 1964a). A detailed revision of and several important contributions to the systematics, anatomy and biology of this family have been made since the 1960s (Lützen 1964a, 1964b, 1966, 1968; Lützen and Jones 1976; Stock 1986). However, our knowledge on the occurrence of most herpyllobiid species is still too scanty, and any record or

information about the mode of parasitism is needed to improve the scarce data available.

Thirteen species of *Herpyllobius* have been described thus far. They differ from each other in the size and shape of the ectosoma and endosoma, ornamentation of the areas between and above the genital swellings with sclerotised dots and/or medio-terminal swelling (terminology according to Stock 1986), size and dimensions of the egg sacs, and in the location of the parasite on the host's body (Lützen 1964a).

During the recent EASIZ cruises ANT XIII/3 and ANT XV/3 in Antarctic waters in the summers of 1996 and 1998, respectively, some specimens of *Herpyllobius* were collected. In this paper we present a new record and a new evaluation of the description of *Herpyllobius antarcticus* Vanhöffen, 1913, plus a description of two new species, *H. polarsterni* and *H. stocki*. With the discovery of these 2 new species, 15 species of the genus are now known, 7 of which are restricted to the southern oceans.

Materials and methods

Polychaetes infected with parasitic copepods were collected in Antarctic waters (Fig. 1) during the EASIZ cruises ANT XIII/3 and ANT XV/3 on board the R/V *Polarstern* during the summers of 1996 and 1998, respectively. The material was collected with the aid of a bottom trawl, sorted, labelled and fixed (5% formalin in seawater) on board.

The copepods were removed from the polychaetes under a stereomicroscope, and transferred to 70% ethanol. For light microscopical investigations, some specimens were stained with Chlorazole black E, partially dissected, mounted in lactophenol and sealed with Entellan. All figures were drawn with the aid of a camera lucida.

For scanning electron microscopy (SEM) studies, selected specimens previously fixed in formalin were washed in distilled water, postfixed in 1% OsO₄, dehydrated, and subsequently critical-point dried, mounted on stubs, coated with gold-palladium and observed with a JEOL-JSM 840.

The species studied in this paper have been deposited in the Zoologisches Institut und Zoologisches Museum, Hamburg (ZIZMH), the Department of Zoology of the Royal Veterinary and

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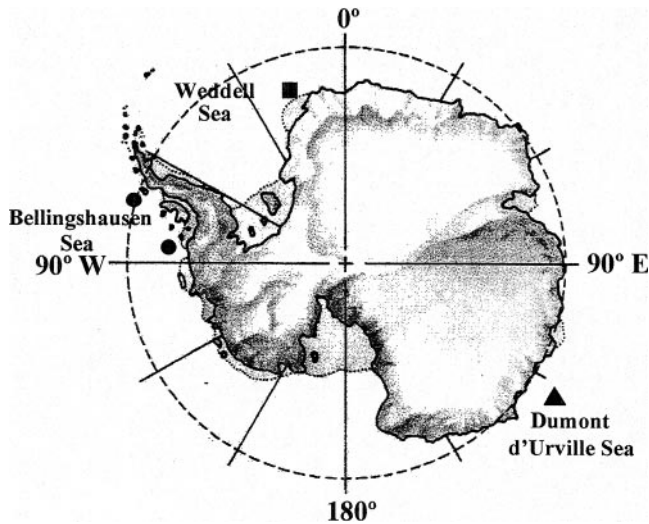


Fig. 1 Geographical distribution of the species of *Herpyllobius* studied in the present work. Key: ■ present material of the three *Herpyllobius* species described here; ● Gravier's (1913) record of *Herpyllobius antarcticus*; ▲ Vanhöffen's (1913) record of *Herpyllobius antarcticus*

Agricultural University in Copenhagen (KVL-ZS), and the Laboratorio de Biología Marina (LBM) of the University of Seville, Spain.

Results

Herpyllobiidae Hansen, 1892

Herpyllobius Steenstrup & Lütken, 1861

Herpyllobius antarcticus Vanhöffen, 1913
(Figs. 2A, B, 3)

Herpyllobius arcticus Gravier, 1912, 1913

Material examined. Four females, one of them ovigerous, parasitising one specimen of an unidentified polynoid, EASIZ I cruise ANT XIII/3, stn. 39/017, 73°19.1'S 21°14.9'W, 465-m depth, Weddell Sea, Antarctica. The material is deposited in the LBM, and the KVL-ZS.

Description of the females (Figs. 2A, 3A–C). Ectosoma up to 1.8 mm in length, from heart-shaped to pyriform, somewhat pointed towards the anterior end, the underside rather rounded, lateral surfaces of the ectosoma with deep longitudinal ridges. The genital swellings are heavily sclerotised, but not very prominent, with a slightly vaulted area between them, and a prominent sclerotised medio-terminal swelling on the anterior area, where copepodids and males are found. Ovisacs are ovoid to pyriform, terminally rounded, up to 0.9 mm in length and 0.6 mm in width. Stalk elongated, emerging from the underside of the ectosoma, not clearly displaced to genital or anterior areas. Sclerotised ring present, with border curved towards the ectosoma, and free edge

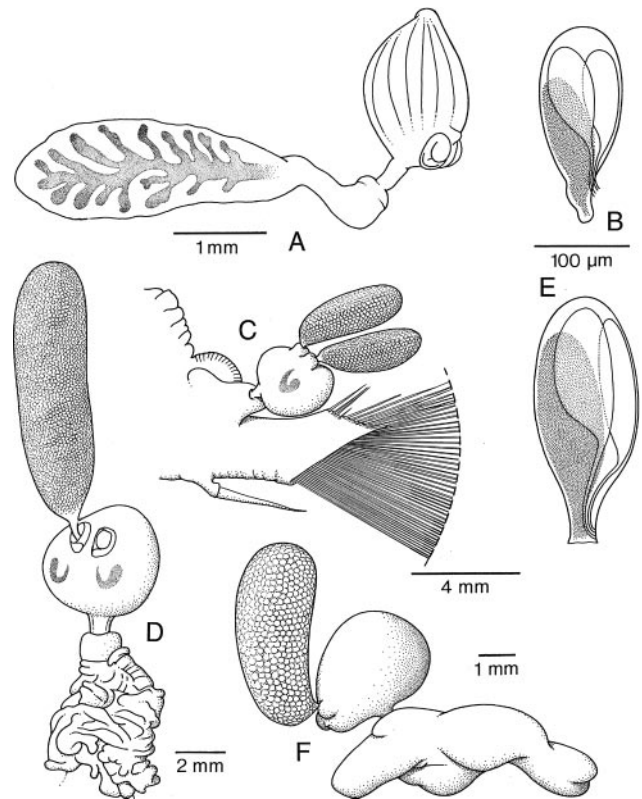


Fig. 2A, B *Herpyllobius antarcticus* Vanhöffen, 1913. **A** Adult female. **B** Adult male showing both spermatophores, remains of the copepodid exuvium are not illustrated. **C–E** *Herpyllobius polarsterni* sp. nov. **C** Oviparous female (holotype) attached to the host's parapodium. **D** Oviparous female removed from the host, showing ecto- and endosoma. **E** Adult male showing both spermatophores; remains of the copepodid exuvium are not illustrated. **F** *Herpyllobius stocki* sp. nov.; oviparous female (holotype). Drawn by B. Beyerholm

smooth (Fig. 3C). Endosoma tongue-shaped, and by transparency, a system of diverticula may be noticed.

Description of the males (Figs. 2B, 3D). Body flask-shaped, 200 µm in length and 88 µm in width, without appendages. Two spermatophores visible through the cuticle. Males attached to the region above the genital swellings.

Position on host. Invariably, the parasite is attached to the prostomium of the polynoid host, with the endosomal part placed along the dorsal wall of the host's proboscis, as was pointed out by previous authors.

Distribution. Previous records of *H. antarcticus* refer to the species from the Kaiser Wilhelm II land associated with the polynoid *Eniplo rhombigera* Ehlers 1912 (Vanhöffen 1913) (*E. rhombigera* was synonymised with *Polyeunoa laevis* McIntosh 1885 by Hartman 1964; B. Hilbig, personal communication), and at the opposite side of Antarctica, the Bellingshausen Sea, associated with the polynoid *Harmothoe gourdoni* Gravier 1911 (Gravier 1912, 1913). The circumantarctic distribution

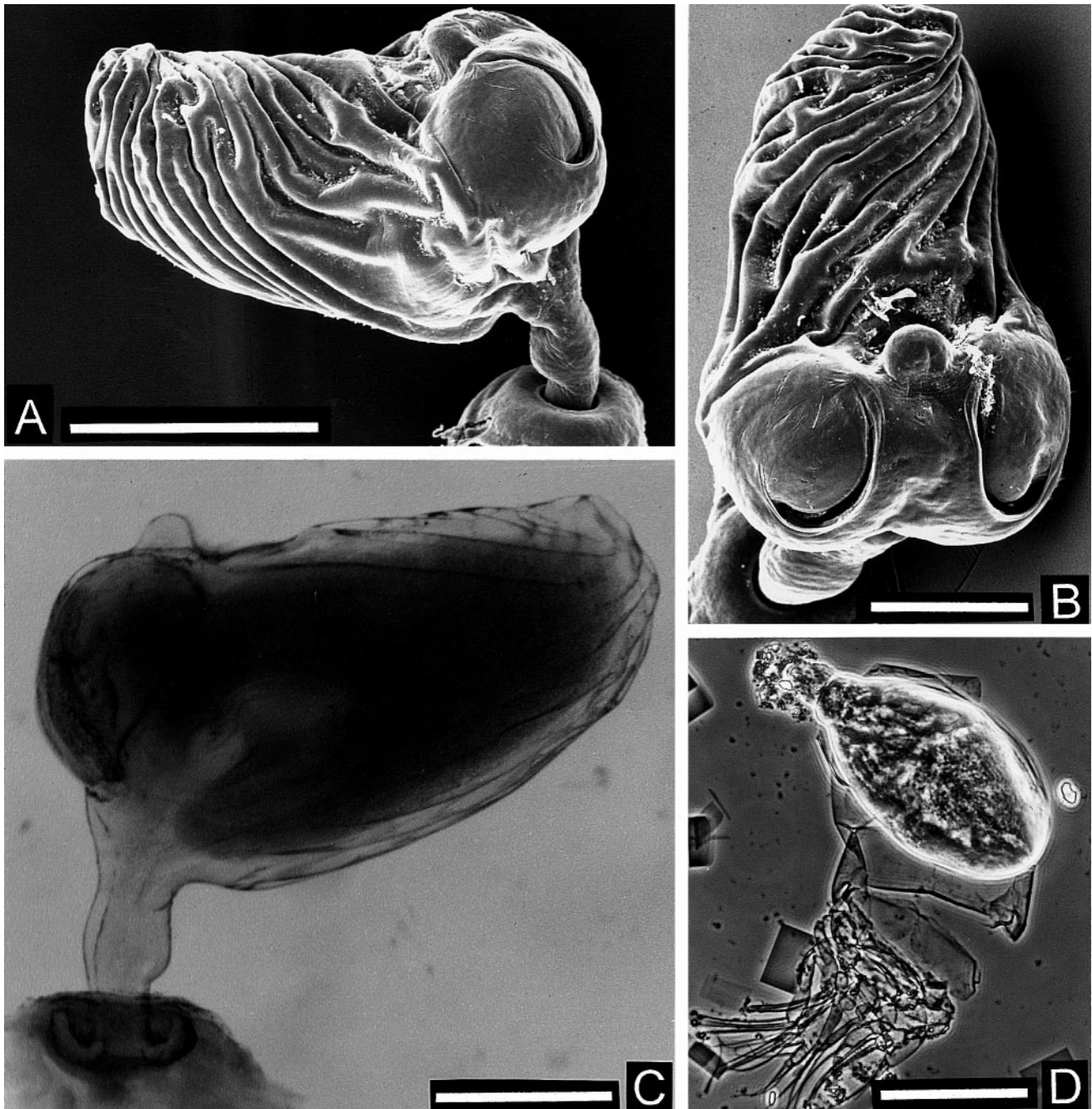


Fig. 3A–D *Herpyllobius antarcticus* Vanhöffen, 1913. **A** Adult female, ectosoma lateral. **B** Adult female, ectosoma dorsal. **C** Adult female, ectosoma cleared using lactic acid, showing by transparency the structure of the sclerotised ring. **D** Adult male and remains of the copepodid exuvium. Scale bars: **A** 500 µm; **B** 300 µm; **C** 500 µm; **D** 100 µm

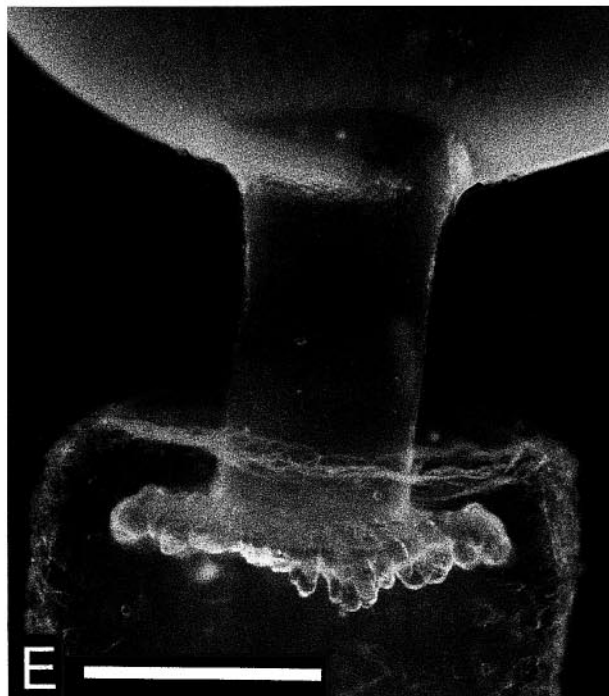
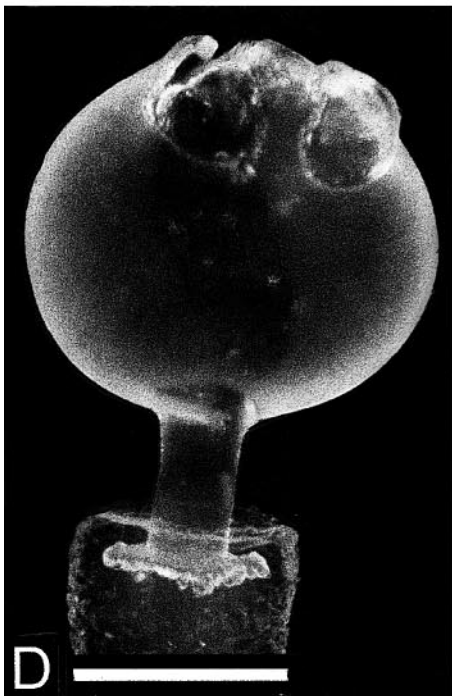
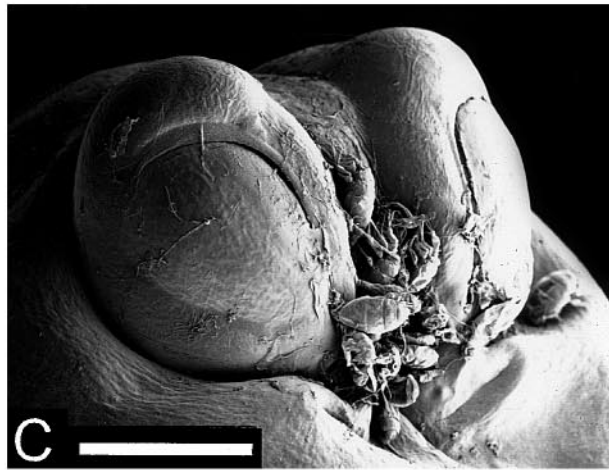
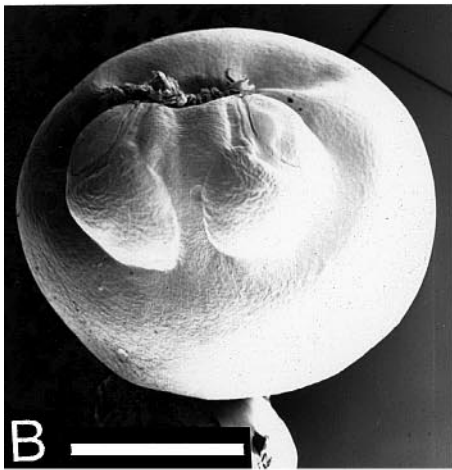
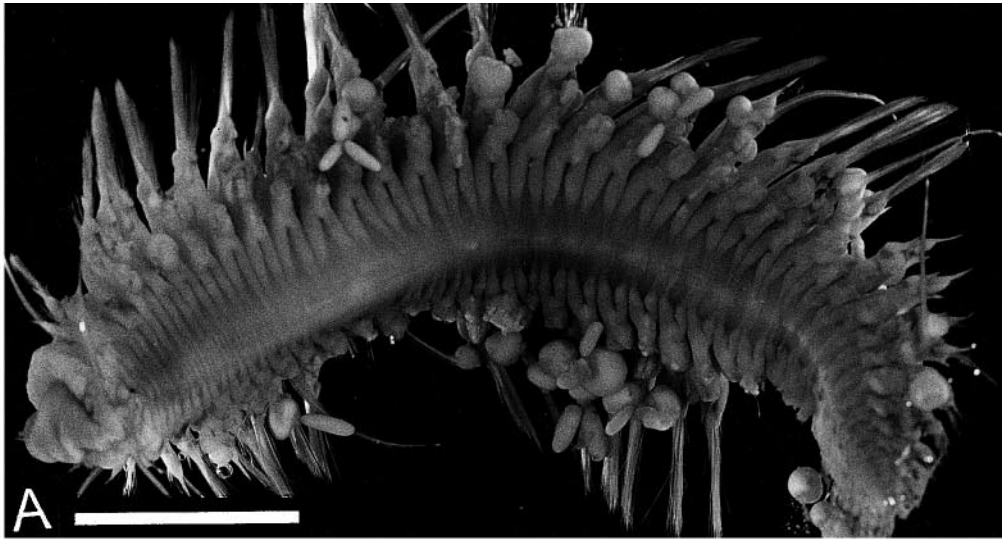
of *Herpyllobius antarcticus* is confirmed with the present material from the eastern Weddell Sea (see Fig. 1).

Remarks. *Herpyllobius antarcticus* is clearly distinguishable from other *Herpyllobius* species as demonstrated by Vanhöffen (1913) and Lützen's revision (1964a). In the present account we update the diagnostic characteristic of this species.

***Herpyllobius polarsterni* sp. nov.** (Figs. 2C, D, E, 4, 5)

Material examined. More than 50 ovigerous and non-ovigerous females parasitising 3 specimens of the polynoid *Eulagisca gigantea* Monro 1939 collected during the EASIZ II cruise ANT XV/3, stn. 48/084, 72°51'S, 19°18.8'W, 391- to 395-m depth, Weddell Sea, Antarctica (the polynoids are deposited in the LBM and ZIZMH, P-23678). The holotype and paratypes have been deposited in the ZIZMH (K-39544).

Description of the females (Figs. 2C, D, 4). Ectosoma up to 4.6 mm in length, heart-shaped, somewhat pointed



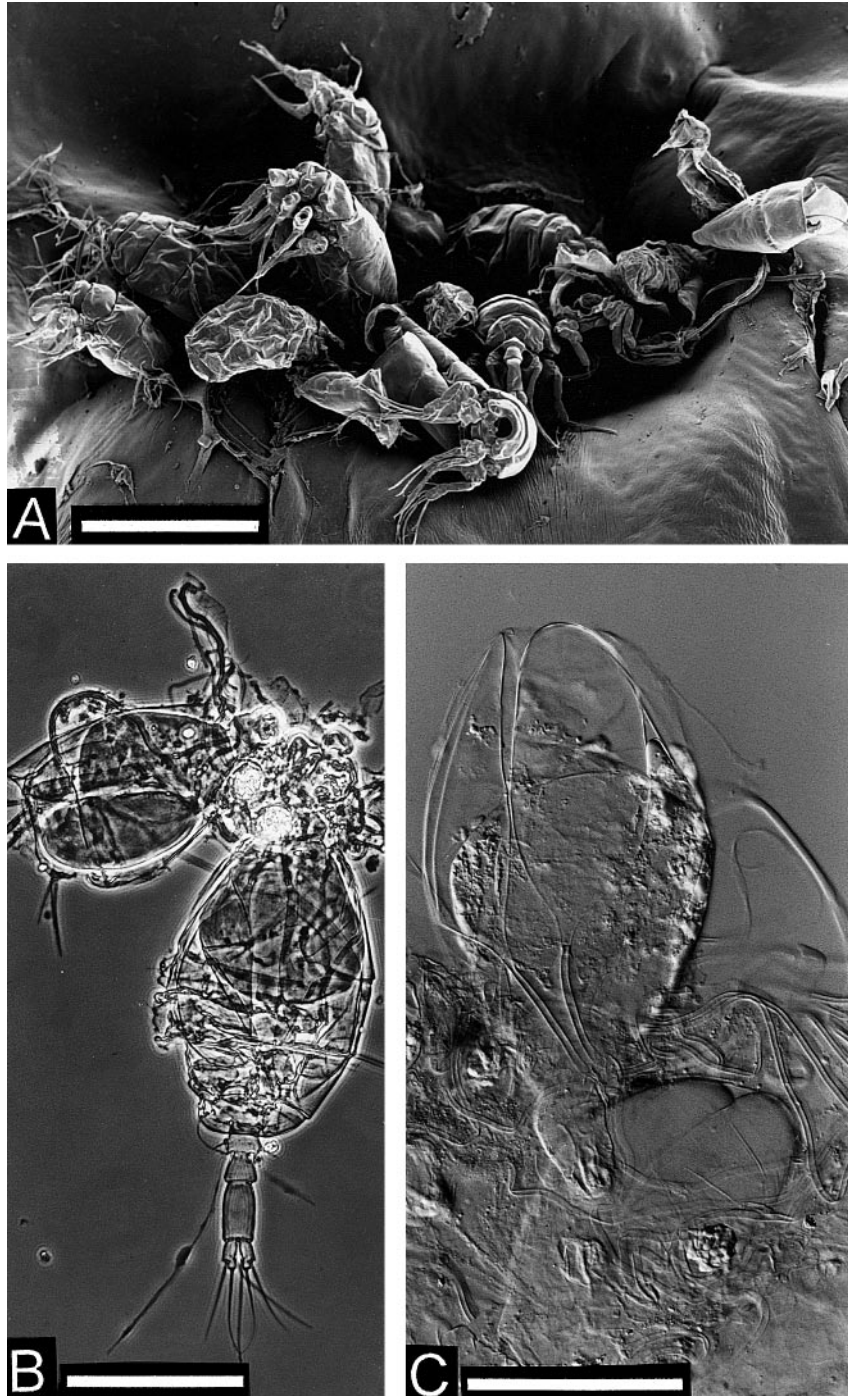
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Fig. 4A–E *Herpyllobius polarsterni* sp. nov. **A** Polynoid host highly parasitised. **B** Ectosoma. **C** Detail of genital swellings and attached males. **D** Ectosoma cleared using lactic acid, showing by transparency the structure of the sclerotised ring. **E** Detail of the sclerotised ring border. Scale bars: **A** 20 mm; **B** 1 mm; **C** 500 μ m; **D** 1 mm; **E** 500 μ m

towards the anterior end, the underside rather rounded. The genital swellings are prominent and heavily sclerotised, with a slightly vaulted area between them, but without any distinct bulge or sclerotised dots on the

anterior concave area, where copepodids and males are abundant. Ovisacs straight and elongated, and terminally rounded, up to 9 mm in length and 2.5 mm in width. Stalk distinct, emerging from the underside of the ectosoma, not clearly displaced to genital or anterior areas. Sclerotised ring present; cleared in lactic acid showing short digitate processes (Fig. 4D, E). Endosoma massive, lump-shaped, with wrinkled surface.

Description of the males (Figs. 2E, 4C, 5). Body flask-shaped, 260 μ m in length and 110 μ m in width, without

Fig. 5A–C *Herpyllobius polarsterni* sp. nov.; adult males. **A** Males attached to the area between genital swellings. **B** Note the spermatophores in the remains of copepodid exuvium. **C** Note the spermatophores and the numerous spermatid tubes. Scale bars: **A** 200 μ m; **B** 150 μ m; **C** 100 μ m



appendages (Fig. 2E, 5A, B). Two spermatophores visible through the cuticle. Males attached to the region above the genital swellings (Figs. 4B, 5A).

Position on host. The parasite does not show any preference for particular sites along the host's main body axis; however it is always located on the dorsal part of the neuropodia, with the posterior part of the ectosoma directed laterally (Fig. 2C, 4A).

Etymology. The specific name *polarsterni* refers to the German research vessel R/V *Polarstern*, on which the EASIZ cruises ANT XIII/3 and ANT XV/3 were carried out.

Discussion. According to Lützen and Jones (1976), the species included in the genus *Herpyllobius* can be arbitrarily separated into three groups according to the ornamentation between and above the genital swellings. The first group includes five species of *Herpyllobius* with sclerotised dots in the area above the genital swellings, usually arranged in a semicircle; the number of dots is usually four (*Herpyllobius arcticus* Steenstrup & Lütken 1861 and *Herpyllobius elongata* Lützen 1967), in one species only two are distinct (*Herpyllobius hartmanae* Lützen & Jones 1976), and in the remaining two species, these sclerotised dots encircle a slightly prominent hump [*Herpyllobius polynoes* (Krøyer 1863) and *Herpyllobius rotundus* Lützen & Jones 1976]. The second group includes those species of *Herpyllobius* in which the two genital swellings are separated by a protruding and heavily sclerotised medio-terminal swelling (*Herpyllobius antarcticus* Vanhöffen, 1913; *Herpyllobius cordiformis* Lützen 1964; *Herpyllobius australis* Lützen 1964; *Herpyllobius gravieri* Lützen 1964; *Herpyllobius nipponicus* Lützen 1964; *Herpyllobius antepositus* Stock 1986; and *Herpyllobius lobosaccus* Stock 1986). The third group is, until now, represented by a single species, *Herpyllobius haddoni* Lützen 1964, which is characterised by the lack of sclerotised dots or bulges in that area (for more details about all of these species see Lützen 1964a, b, 1966, 1968; Lützen and Jones 1976; Stock 1986).

Herpyllobius polarsterni can be placed within the third group, close to *Herpyllobius haddoni*. In *Herpyllobius polarsterni*, the sclerotised genital swellings are very close to one another, and this small area is slightly vaulted, but does not form any distinct bulge. The relative position of the genital swellings is very similar to those shown by Lützen (1964a, b) for *Herpyllobius cordiformis*, but they lack the sclerotised medio-terminal swelling.

According to the shape of the ectosoma, *Herpyllobius polarsterni* is close to *Herpyllobius antarcticus*, and *Herpyllobius cordiformis*; however, *Herpyllobius antarcticus* has a more pyriform and slightly furrowed ectosoma but the relative position of the genital swellings coincides with that in *Herpyllobius polarsterni*. *Herpyllobius cord-*

iformis is easily distinguishable from *Herpyllobius polarsterni* by the position of the genital swellings, which are very close to the stalk, while in *Herpyllobius polarsterni* these structures are well separated.

The shape of the endosoma in *Herpyllobius polarsterni* is similar to that of *Herpyllobius cordiformis*, *Herpyllobius arcticus*, *Herpyllobius australis* and *Herpyllobius elongata*, but in general it displays a much more complex system of diverticula than in these four species.

From the five previously described species in the genus *Herpyllobius* in the southern oceans, *Herpyllobius antarcticus*, *Herpyllobius australis*, *Herpyllobius gravieri*, *Herpyllobius hartmanae* and *Herpyllobius rotundus*, *Herpyllobius polarsterni* is, from the dimensions of the ectosoma and position on the hosts, only comparable with *Herpyllobius hartmanae*. Moreover, in *Herpyllobius hartmanae*, the genital swellings are relatively inconspicuous and placed close to the stalk, there are sclerotised dots between these structures, the underside of the ectosoma is fairly flat, and the endosoma is fundamentally tongue-shaped (Lützen and Jones 1976). In contrast, in *Herpyllobius polarsterni*, the genital swellings are well pronounced and separated from the stalk, without sclerotised dots between these structures, the underside of the ectosoma is curved, and the endosoma is massive and wrinkled.

Herpyllobius stocki sp. nov. (Fig. 2F)

Material examined. One ovigerous female parasitising a specimen of the polynoid *Austroaenilla antarctica* Bergström 1916, collected during the EASIZ II cruise ANT XV/3, stn. 48/082, 72°50.8'S, 19°18.8'W, 395- to 417-m depth, Weddell Sea, Antarctica (the polynoid is deposited in ZIZMH, P-23683). The holotype has been deposited in the ZIZMH (K-39543).

Description of the female (Fig. 2F). Ectosoma 3.7 mm in length and 2.7 mm maximum width, pear-shaped, the underside rather flat. Genital swellings prominent and heavily sclerotised, with a medio-terminal swelling between them slightly placed to the ventral side, but without sclerotised dots. No males or copepodids were observed. Ovisacs sausage-shaped, short and thick, terminally rounded, up to 5 mm in length and 2.1 mm in width. Stalk short and thick, issuing from the midline of the underside. Characteristics of the sclerotised ring have not been observed due to the scarcity of material available. Endosoma elongated with a few blunt processes, 7.3 mm in length and 2.4 in width.

Position on host. The parasite is located on the dorsal part of the neuropodium, with the ectosoma directed laterally.

Etymology. This species is named after the late carcinologist Jan H. Stock.

Discussion. Of the three groups of *Herpyllobius* species mentioned above, *Herpyllobius stocki* should be compared with the second one, in which the two genital swellings are separated by a protruding medio-terminal swelling. The shapes of the ectosoma, endosoma and ovisacs are valid characteristics which serve to distinguish *Herpyllobius stocki* from all the species included in these groups. In addition, the position of the medio-terminal swelling is mid-dorsal or dorsal in the other species, but mid-ventral in *Herpyllobius stocki*. Only *Herpyllobius nipponicus* seems to be close to the new species. However, according to the description given by Okada (1932) and later compiled by Lützen (1964a), the two species are quite different. *Herpyllobius stocki* differs from *Herpyllobius nipponicus* in the size and shape of the ectosoma; *Herpyllobius nipponicus* measures about 2.1 mm in length and 1.75 mm in width with a globular ectosoma, while *Herpyllobius stocki* reaches a length of 3.7 mm and 2.7 mm in width with a pyriform ectosoma. The stalk emerges in *Herpyllobius nipponicus* at a point not far in front of the two genital swellings, while in *Herpyllobius stocki* the stalk issues from the middle of the underside. The endosoma in *Herpyllobius nipponicus*, disc-like in shape and provided with many blunt processes, is about 2.5 mm in length, whereas the endosoma in *Herpyllobius stocki* is elongated and rather longer (7.3 mm) with discrete blunt processes. According to Okada, the genital swellings are shield-shaped and placed rather far apart from each other, with a medio-terminal swelling comparable to those of the other species in this group. In contrast, the genital swellings in *Herpyllobius stocki* are close to one another, and there is a medio-terminal swelling placed mid-ventrally.

Acknowledgements We wish to thank Dr. Brigitte Hilbig (Zoologisches Institut und Zoologisches Museum, Hamburg) for identifying the species of polynoids and valuable information, and Dr. Maria Cristina Gambi (Stazione Zoologica "A. Dohrn", Naples) for useful suggestions. Cova Orejas, Dr. Victor Alvà and Dr. Mikel Zabala collected the material of *Herpyllobius antarcticus* studied here during the EASIZ I cruise ANT XIII/3. We are grateful to our colleague J. Lützen who supplied the photograph reproduced in Fig. 4A. Support for this work was provided by two CICYT grants, ANT97-1533-E and ANT98-1739-E.

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