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A new Spionidae (Polychaeta) from North Carolina, and a redescription of *Marenzelleria wireni* Augener, 1913, from Spitsbergen, with a key for all species of *Marenzelleria*

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Abstract *Marenzelleria bastropi*, a new species of Spionidae (Polychaeta) from the brackish water Currituck Sound, North Carolina, is described. The new species is characterized by the great number of chaetigers between the first neuro- and notopodial hooded hooks, the extension of the nuchal organ up to the end of chaetiger 2/middle of chaetiger 3 and the presence of about 60–90 branchiate chaetigers. *Marenzelleria bastropi* sp. nov. is closely related to *M. neglecta* (Sikorski and Bick, 2004) and *Marenzelleria viridis* (Verrill, 1873). *Marenzelleria wireni* Augener, 1913 is described here for the first time from western Spitsbergen. Adult specimens are investigated and compared with specimens from other areas of distribution. A key for subadult and adult specimens of all *Marenzelleria* species is provided.

Keywords *Marenzelleria bastropi* sp. nov. · Currituck Sound · *Marenzelleria wireni* · Spitsbergen

Introduction

During studies on the identity and distribution of *Marenzelleria* species in European and North American brackish waters specimens were found in Currituck Sound, North Carolina, that could not be assigned to any known species. These specimens were discovered independently of one another through genetic and morphological investigations. Besides the two genetic types (Type I and Type II) that were later determined as *Marenzelleria* cf. *wireni* and *M. cf. viridis*, a third genetic type (Type III) was restricted to Currituck Sound; it was

sympatric with Type II (37 specimens of Type III and 72 of Type II) (Bastrop et al. 1997). Morphological investigations yielded one anterior fragment (*Marenzelleria* sp. A) which also markedly differed from species known from boreal regions (Bick and Zettler 1997). Specimens recently collected from the Currituck Sound now make a formal description of this species possible, although only anterior fragments are available again.

Moreover, several specimens of *M. wireni* were recently collected from a glacier fjord in western Spitsbergen. It represents the third record of *M. wireni* from Svalbard and the first from the west coast of Spitsbergen. For the first time, several complete adult specimens rather than a single specimen or anterior fragments are available. These specimens will help during morphological and genetic investigations as part of a preliminary study for phylogenetic and phylogeographic analyses of all *Marenzelleria* species. The results of the morphological investigations on *M. wireni* are provided in this paper, and the analyses will be presented in a later contribution. A key to all species of *Marenzelleria* is also provided.

Methods

The specimens of *Marenzelleria bastropi* sp. nov. were collected in intertidal areas in Currituck Sound, North Carolina, in June 1995 and October 2002. The salinity at the sampling locality was about 4 psu (June 1995) but the sediment character is unknown. The samples were fixed in borax-buffered formalin (1995) or ethanol (2002). The specimens of *M. wireni* were collected in intertidal and shallow subtidal areas of the Kolhamna Bukta, Kongsfjorden, near Ny Ålesund, Spitsbergen, in June 2003. Here, oceanic water of 29.8 psu was overlain by brackish water of 4.6 psu. The sediment consisted of fine well-sorted sand with a relatively small amount of organic matter. Before specimens were fixed with a 4% buffered formalin solution they were anaesthetized by carefully adding carbonated fresh-water. For SEM

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studies, specimens were dehydrated in a critical point drier, attached to a stub and sputter-coated with gold palladium. SEM observations were made with a Zeiss DSM 960 A. Methylene green staining was employed to visualise the extension of the nuchal organ and glandular body regions. All specimens examined in the present study are deposited in the Zoologische Sammlung der Universität Rostock (ZSRO); catalogue numbers see below.

Results

Spionidae Grube, 1850

Marenzelleria Mesnil, 1896

Type species: *M. wireni* Augener, 1913

Marenzelleria bastropi sp. nov.

Synonymy: *Marenzelleria* sp. A—Bick and Zettler (1997): 143, Sikorski and Bick (2004): 271, Fig. 8; *Marenzelleria* Type III—Bastrop et al. 1997: 126–127, 1998: 99–100.

Material examined: Holotype: Currituck Sound, North Carolina, Waterlilly, 31.10.2002, coll. D.M. Dauer, (ZSRO-P1637). Paratypes: Currituck Sound, North Carolina, Waterlilly, 31.10.2002, coll. D.M. Dauer, (one specimen, ZSRO-P1638); Currituck Sound, North Carolina, eulittoral, salinity 4 psu, June 1995, coll. R. Bastrop (one specimen, ZSRO-P 45); Nontype material: Currituck Sound, North Carolina, Waterlilly, 31.10.2002, coll. D.M. Dauer, three specimens (used for both scanning electron microscope and genetic analyses).

Diagnosis

Holotype: anterior fragment with 85 chaetigers; maximum width about 2.1 mm; body somewhat flattened; anterior margin of prostomium broadly rounded, notched medially; prostomium bell shaped; eyes not visible; palps broken off; nuchal organ up to the end of chaetiger 2; midsegmental and intersegmental dorsal ciliated crest present from chaetiger 2 and between chaetiger 2 and 3 (Figs. 1a, d, 2a); branchiae from chaetiger 1 up to chaetiger 77, branchiae on the first chaetigers distinctly longer than postsetal lamellae of the notopodium, touch dorsally on chaetigers 1–3 (Fig. 1b, 2b, c); branchiae increase in length up to chaetiger 6, of equal length from chaetiger 6 up to about chaetiger 35, and decrease markedly in length on most posterior chaetigers; postsetal lamellae present on all chaetigers, inconspicuous on most posterior chaetigers; postsetal notopodial lamellae and branchiae fused basally, on first ten chaetigers pointed dorsally, after that rounded (Fig. 1b, c), about twice as long as wide anteriorly, square or rounded posteriorly; postsetal neuropodial lamellae much smaller than notopodial lamellae, rounded in all but posteriormost chaetigers; all chaetigers with capillary chaetae, supe-

rior dorsal chaetae longest, most striking on chaetigers 1–3, where they raised dorsally; ventrally curved tapering sabre chaetae start from neuropodium 4, with one to three in each fascicle; hooded hooks are present in neuro- and notopodium, neuropodial hooks first appear on chaetiger 44, notopodial hooks start on chaetiger 67; hooks are bidentate with a small tooth above the main tooth, sometimes small tooth reduced or doubled (Fig. 1e, f, 2 d); no distinct methylene green staining pattern.

Remarks

The characters of the investigated specimens are presented in Table 1. *Marenzelleria bastropi* sp. nov. is characterized by the great number of chaetigers (23–28) between the first neuropodial and the first notopodial hooded hooks. All other known species of *Marenzelleria* have about 10–12 (maximum 15) chaetigers between the first neuropodial and the first notopodial hooks. Moreover, no other adult specimens of *Marenzelleria* show the following combination of characters, nuchal organ extending up to the end of chaetiger 2/middle of chaetiger 3 (Fig. 1a), and up to 90 branchiate chaetigers. The most closely related species are *M. neglecta* Sikorski and Bick, 2004 and *M. viridis* (Verrill, 1873). Subadult specimens of *M. neglecta* have a nuchal organ of similar length (Fig. 3c), but they have fewer branchiate chaetigers (Table 1). *Marenzelleria viridis* possesses a similar number of branchiate chaetigers, but the nuchal organ does not cross the midsegmental ciliated crest on chaetiger 2 (Fig. 3d). Consideration has been given to the fact that all diagnostic characters (length of nuchal organ, number of branchiate chaetigers, first appearance of neuro- and notopodial hooded hooks) of *Marenzelleria* species are size-dependent (Bick and Zettler 1997; Sikorski and Bick 2004). Moreover, identification is not only based on the combination of characters but also on the inclusion of ‘secondary characters’ (arithmetical differences between morphological characters) (Sikorski and Bick 2004).

Among the investigated material, one specimen (without catalogue number*) differed remarkably from the others (Table 1): the number of chaetigers between first appearance of noto- and neuropodial hooded hooks is 12. This number agrees with those found in the other *Marenzelleria* species. The two other important characters found on this specimen—length of nuchal organ and number of branchiate chaetigers—is certainly unique among *Marenzelleria* species. Genetic analysis detected a correspondence between this specimen and all others of *M. bastropi* sp. nov. (M. Blank, personal communication) but this phenomenon remains unclear. One potential explanation is hybridisation, such as the one known to occur between *M. neglecta* (= Type II) and *M. viridis* (= Type I): F₁-hybrids have been found in the Elbe estuary (Blank et al. 2004).

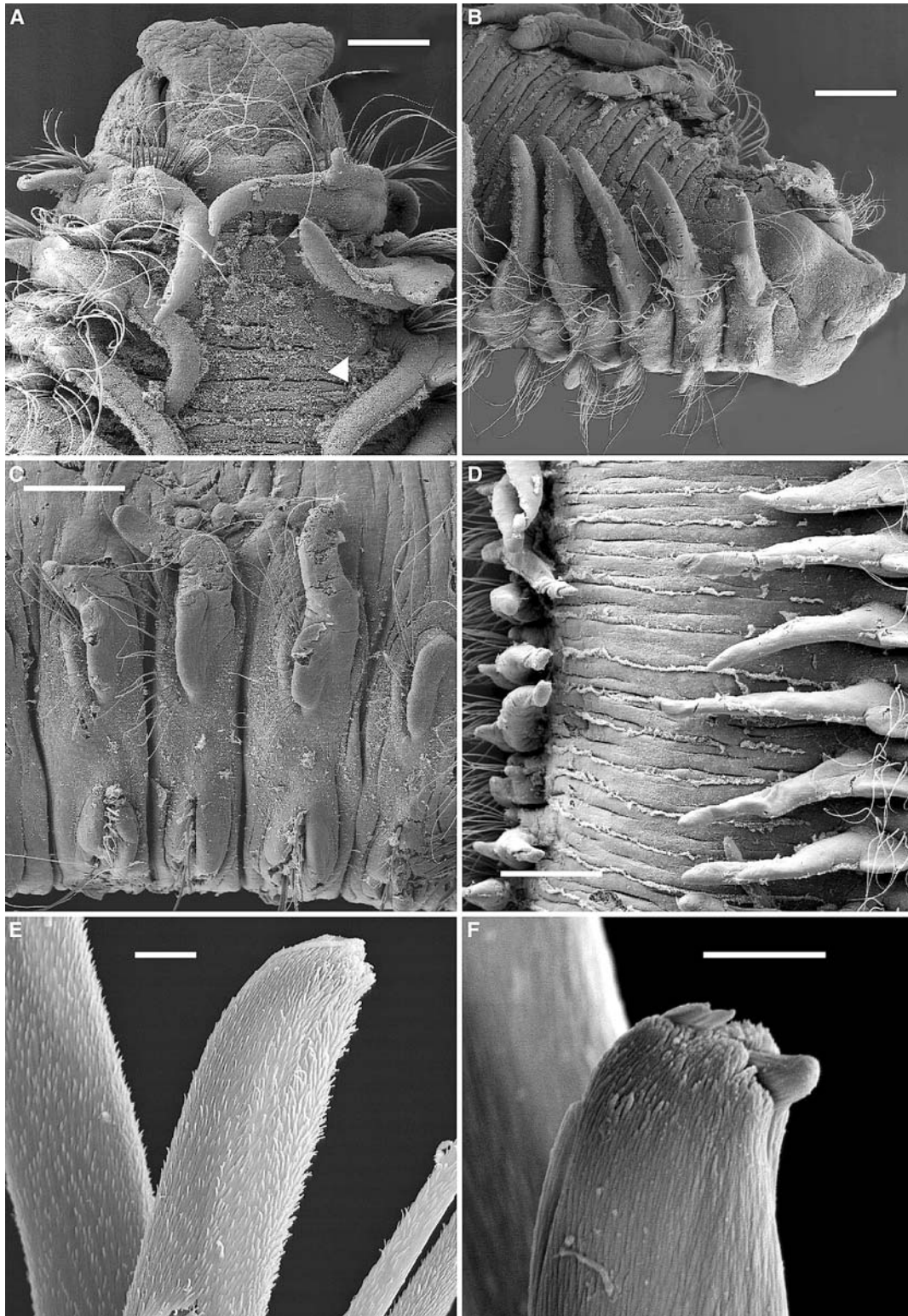


Fig. 1 *Marenzelleria bastropi* sp. nov. **a** Anterior end, dorsal view (arrowhead indicates the posterior margin of the right loop of the nuchal organ). **b** Anterior end, lateral view. **c** Branchiate chaetigers, lateral view. **d** Branchiate region, dorsal view with mid- and

intersegmental ciliated crests. **e** Neuropodial hooded hook, hood closed apically. **f** Tridentate neuropodial hooded hook, hood open; (scale in **a–d** 200 μm , **e, f** 5 μm)

Such a hybridisation is conceivable between *M. bastropi* sp. nov. and *M. neglecta*, which occur sympatrically in Currituck Sound.

Marenzelleria bastropi sp. nov. is only known from the type locality. It was found together with *M. neglecta* at about 4 psu. The ratio of abundance between *M. neg-*

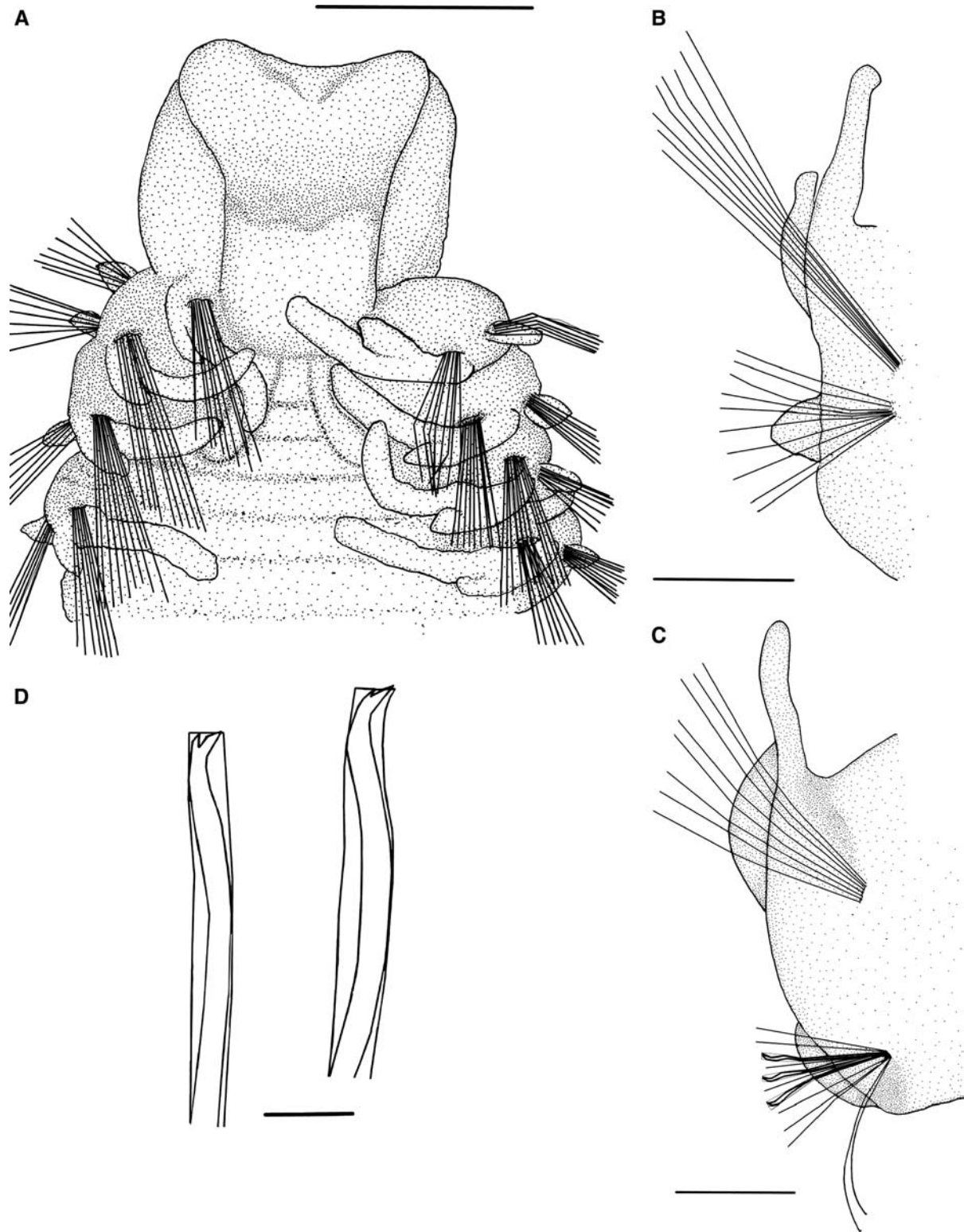


Fig. 2 *Marenzelleria bastropi* sp. nov. **a** Anterior end, dorsal view. **b** Chaetiger 3, anterior view. **c** Chaetiger 45, anterior view. **d** Neuropodial hooded hooks; (scale in **a** 1 mm, **b**, **c** 200 µm, **d** 20 µm)

lecta and *M. bastropi* was about 2:1 in June 1995 and about 30:1 in October 2002. An explanation for this will have to wait until more is known about the ecology and true distribution of *M. bastropi* sp. nov.

Etymology: The species is named after Dr Ralf Bastrop, University of Rostock, to honour him for his contribution to the population genetics of *Marenzelleria* spp. He was the first person to find 'Marenzelleria Type III'.

Table 1 Diagnostic characters of all investigated specimens of *Marenzelleria bastropi* sp. n. with those of all species of *Marenzelleria* (* specimen differed remarkably from all others of *M. bastropi* sp. nov., see remarks; ¹ after Sikorski and Bick (2004); ² after Bick and Zettler (1997); ³ data from specimens recently collected from Spitsbergen)

	Total number of setigers	Length of nuchal organ	Number of branchiate setigers	First appearance of neuropodial hooks on setiger	First appearance of notopodial hooks on setiger	Number of setigers between first appearance of noto- and neuropodial hooks	Number of hook-bearing branchiate setigers
<i>M. bastropi</i> ZSRO-P1637 (Holotyp)	?	Up to end of setiger 2	77	44	67	23	33
<i>M. bastropi</i> ZSRO-P1638 (Paratype)	?	Up to end of setiger 2	63	37	61	24	26
<i>M. bastropi</i> ZSRO-P45 (Paratype)	?	Up to middle of setiger 3	90	47	73	26	43
<i>M. bastropi</i> without number	?	Up to end of setiger 2	80	50	78	28	30
<i>M. bastropi</i> without number	?	Up to end of setiger 2	> 68	46	> 68	> 22	> 22
<i>M. bastropi</i> without number	?	Up to middle of setiger 3	> 72	44	69	25	> 28
<i>M. bastropi</i> without number*	?	Up to end of setiger 2	> 78	42	54	12	> 36
<i>Marenzelleria arctica</i> ¹	Max. 90	Up to middle of setiger 2	Max. 37	About 30–37	About 40–46	About 6–12	Maximal 6–10
<i>M. neglecta</i> ^{1, 2}	Max. 210	Up to middle of setiger 4	Max. 65	About 45–50	About 60–65	About 10–15	Less than 20
<i>Marenzelleria viridis</i> ^{1, 2}	Max. 240	Up to middle of setiger 2	Max. 130	About 45–50	About 60–65	About 10–15	More than 40
<i>Marenzelleria wireni</i> ³	Max. 180	Up to middle of setiger 4	Max. 176	About 35–44	About 47–56	About 9–12	More than 80

Marenzelleria wireni Augener, 1913

Synonymy: *Marenzelleria wireni* Augener, 1913: 264–267, Figs. 1, 2 (partim); Annenkova 1952: 126; Maciolek 1984: 49–51, Figs. 1a–g (partim); Sikorski et al. 1988: 835–837, Fig. 4 (partim); Sikorski and Buzhinskaya 1998: 1112–1115, Fig. 1; Sikorski and Bick 2004: 255–261, Figs. 1, 2a; non Holmquist 1967: 298–313; non *Marenzelleria* cf. *wireni*, Bick and Zettler 1997: 138–141, Figs. 1, 2. *Marenzelleria arctica*, Sikorski and Buzhinskaya 1998 (partim): 1115–1118. *Spio gorbunovi* Averintsev, 1990: 165–166, Fig. 13. *Nerine vulgaris* Wirén, 1883: 408 (partim). *Scolecoplepis* sp. Marenzeller, 1892: 427–429, Fig. 5. *Microspio wireni* Söderström, 1920: 249–250 (partim).

Material examined: Spitsbergen, Kongsfjorden, Kolhamna Bukta near Ny Ålesund, eulittoral, fine sand, 18.06.2003, eight specimens (ZSRO-P1634); Spitsbergen, Kongsfjorden, Kolhamna Bukta near Ny Ålesund, eulittoral, fine sand, 17.06.2003, three specimens (ZSRO-P1635); Spitsbergen, Kongsfjorden, Kolhamna Bukta near Ny Ålesund, eulittoral, fine sand, 19.06.2003, seven specimens (ZSRO-P1636).

Diagnosis

Specimens 40–72 mm long and 106–180 chaetigers; maximum width about 2 mm; body rounded anteriorly and somewhat flattened posteriorly; anterior margin of prostomium broadly rounded, with a small notch medially; prostomium bell shaped; four eyes trapeziformly arranged with posterior pair more closely spaced and dorsally orientated and anterior pair laterally orientated; palps broken off; nuchal organ from posterior margin of prostomium up to middle of chaetiger 3 to the beginning of chaetiger 4 (Fig. 3a); midsegmental and intersegmental dorsal ciliated crest present from chaetiger 2 and chaetiger 2 and 3; first chaetigers with a large number of dorsally located pores (Fig. 3b); branchiae from chaetiger 1 up to chaetigers 88–176, i.e. branchiae are absent only in the very last chaetigers; branchiae in the first chaetigers are distinctly longer than postsetal lamellae of the notopodium and may touch dorsally from chaetiger 1 up to about chaetiger 30; branchiae increase in length up to chaetigers 10–15, then of equal length up to two-thirds of the total number of chaetigers, and decrease markedly in length only in the most posterior chaetigers, triangular anteriorly and threadlike on middle and posterior chaetigers; postsetal lamellae on all chaetigers; postsetal notopodial lamellae and branchiae almost completely fused, distally rounded, about twice as long as wide anteriorly, rounded posteriorly; postsetal neuropodial lamellae much smaller than notopodial lamellae, rounded in all but posteriormost chaetigers; all chaetigers with capillary chaetae, superior dorsal chaetae longest, most striking on anteriormost chaetigers; ventrally curved and tapering sabre chaetae start from neuropodium 4, with three to five in each fascicle; hooded hooks are present in neuro- and noto-

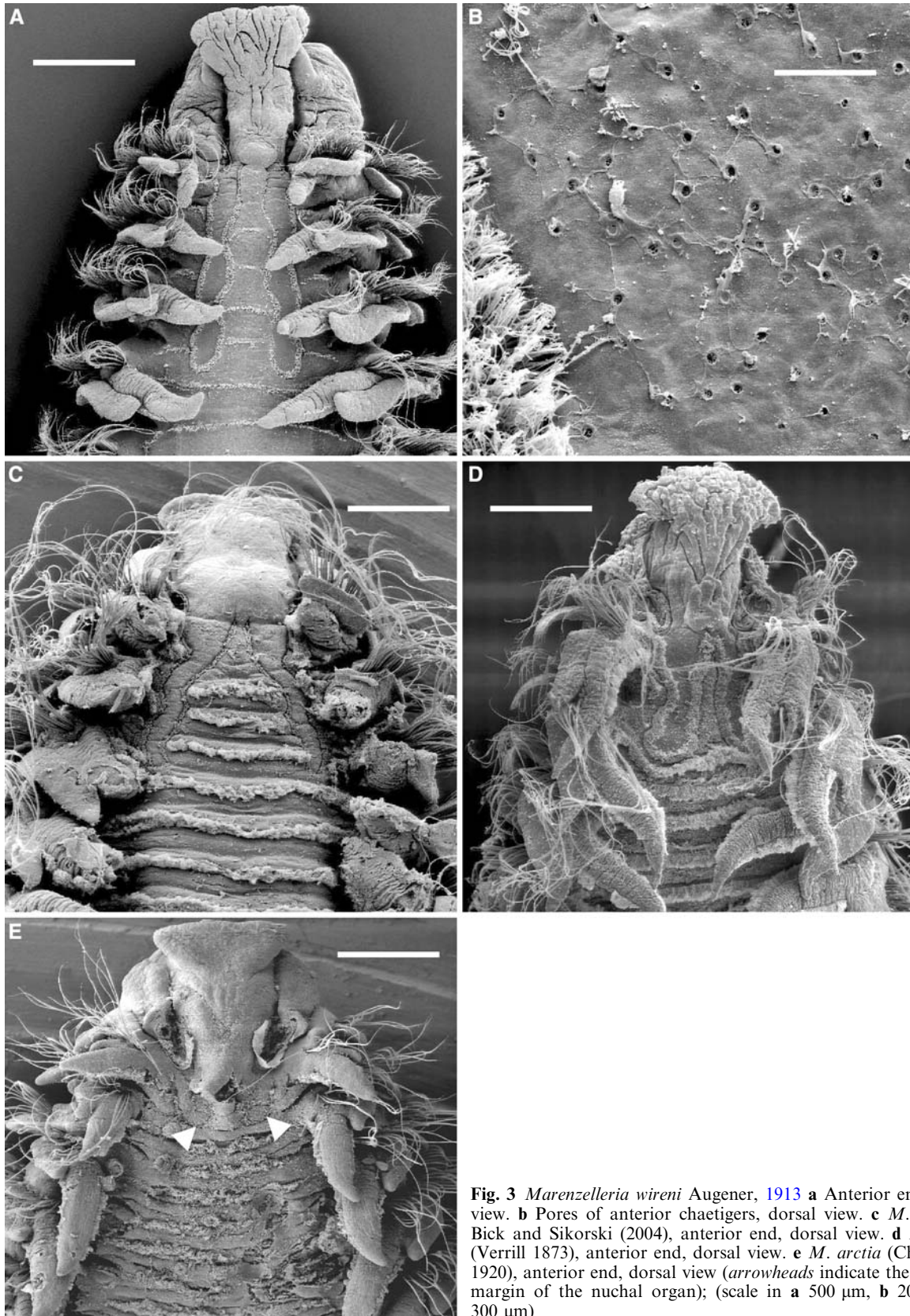


Fig. 3 *Marenzelleria wireni* Augener, 1913 **a** Anterior end, dorsal view. **b** Pores of anterior chaetiger, dorsal view. **c** *M. neglecta*, Bick and Sikorski (2004), anterior end, dorsal view. **d** *M. viridis* (Verrill 1873), anterior end, dorsal view. **e** *M. arctia* (Chamberlin 1920), anterior end, dorsal view (*arrowheads* indicate the posterior margin of the nuchal organ); (scale in **a** 500 μm , **b** 20 μm , **c-e** 300 μm)

podia, neuropodial hooks first appear on chaetigers 35–44, notopodial hooks usually start on chaetigers 47–56; hooks are bi- or tridentate; slit-like anus surrounded by

anal papillae and up to 14 filamentous anal cirri, sometimes branched dichotomously; no distinct methylene green staining pattern.

Remarks

Specimens from Spitsbergen largely agree with those examined by Sikorski and Bick (2004) from other Arctic regions. *Marenzelleria wireni* is clearly characterized by the great number of branchiate chaetigers (Table 1), and the length of the nuchal organ. Only in *M. neglecta* and *M. wireni* does the nuchal organ reach or cross the intersegmental ciliated crest between chaetigers 3 and 4 (Fig. 3a, c). The nuchal organ of the other known Arctic species, *M. arctia*, never crosses the midsegmental ciliated crest of chaetiger 2 (Fig. 3e). The many dorsal pores on the first chaetigers of the Spitsbergen specimens (Fig. 3b) have also been found on a specimen from the White Sea (ZISP 49488) but not on other species of *Marenzelleria*. This may be considered a useful diagnostic character of *M. wireni*.

Marenzelleria wireni has mainly been found in fine-sand brackish habitats of shallow subtidal and upper intertidal areas in the Kongsfjorden near Ny Ålesund, western Spitsbergen, in a benthic community dominated by the polychaetes *Euchone analis* (Krøyer, 1856) and *Pygospio elegans* Claparède, 1863. The maximum abundance was 250 ind. m⁻². It has also been found in subtidal areas (5 and 10 m depth) at an abundance of about 10 ind. m⁻² (Herrmann 2004). Juveniles have not been found, and all specimens collected in this area belong to one size class. Juveniles and adults may prefer different substrates, as is known for *M. neglecta* (Zettler 1996). Remarkably, *M. wireni* has only been found twice before from Spitsbergen, once at Whales-Point Bay, eastern Spitsbergen (Marenzeller 1892, material probably lost), and once at Haketangen, Storfjorden, southeast Spitsbergen (ZMUC-POL 1007). Both were found at a depth of 5–10 m. The former was an anterior fragment, 41 mm long, 2.75 mm wide (with or without parapodia?) and possessing 148 chaetigers, the latter was a juvenile specimen with a length of 17 mm and 96 chaetigers. It is possible that the sampling methods used by us and by SCUBA-divers (Herrmann 2004)—a tube corer and an airlift system, respectively, each sampling the uppermost 20 cm—are more efficient for this tube-dwelling polychaete.

Key for *Marenzelleria* species

The following key is based on the characteristics of subadult and adult specimens (e.g. width about > 1.2 mm). Methylene green staining may be helpful to see the nuchal organ. Additional characters for species are provided in parentheses.

- 1 Branchiae on all chaetigers except on the very last; nuchal organ at least up to the end of chaetiger 3/beginning of chaetiger 4, i.e. crossing the intersegmental ciliated crest of chaetigers 3/4 (Fig. 3A); (up to 180 chaetigers; Arctic species).....*M. wireni* Augener, 1913
- Two third of all chaetigers with branchiae at most; nuchal organ up to end of chaetiger 2 or 3..... 2
- 2 More than 20 chaetigers between first appearance of neuro- and notopodial hooded hooks; (nuchal organ from end of chaetiger 2 to middle of chaetiger 3, i.e. reaching the intersegmental ciliated crest of chaetigers 2/3 at least (Fig. 1A); more than 60 branchiate chaetigers; boreal species).....*M. bastropi* sp. nov.
- Maximum of 15 chaetigers between first appearance of neuro- and notopodial hooded hooks.....3
- 3 Nuchal organ up to the end of chaetiger 3, i.e. crossing the intersegmental ciliated crest of chaetiger 2/3 at least (Fig. 3C); (max. 65 branchiate chaetigers, i.e. less than one-third of total number of chaetigers; length of branchiae decreases over about 10-15 chaetigers, after that branchiae absent; up to 210 chaetigers; boreal and (Arctic?) species)*M. neglecta* Sikorski and Bick, 2004
- Nuchal organ much shorter, not crossing the midsegmental ciliated crest of chaetiger 2.....4
- 4 About 30-40 branchiate chaetigers; length of branchiae decreases over about 10-15 chaetigers, after that branchiae absent; (nuchal organ reaches the midsegmental ciliated crest of chaetiger 2 (Fig. 3E); less than 100 chaetigers; Arctic species)*M. arctia* (Chamberlin, 1920)
- About 60-130 branchiate chaetigers, length of branchiae decreases over about 30-60 chaetigers; (nuchal organ reaches the midsegmental ciliated crest of chaetiger 2 (Fig. 3D); 170-240 chaetigers, boreal species).....*M. virdis* (Verrill, 1873)

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