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Andreas Bick ^a

^a FB Biowissenschaften , Allgemeine and Spezielle Zoologie , Universität Rostock , Rostock, Germany

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A new polychaete genus and species of the Kongsfjorden, Spitsbergen, Svalbard

ANDREAS BICK

FB Biowissenschaften, Allgemeine and Spezielle Zoologie, Universität Rostock, Rostock, Germany

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Abstract

Glyphochaeta laudieni, a new genus and species of the “Spionidae”, is described from the Arctic. The specimens were collected from the Kongsfjorden, Spitsbergen, Svalbard, in a marine grotto. *Glyphochaeta laudieni* was associated with colonies of unidentified Bryozoa. This new genus and species is characterized by a prostomium with frontal horns, the absence of branchiae and sabre chaetae, and the presence of grooved spines which replace hooded hooks in some chaetigers of the middle body region. These spines are associated with glandular organs situated in neuropodia. The significance of characters for determining the systematic position of *Glyphochaeta* within “Spionidae” is discussed. *Glyphochaeta laudieni* is probably related to *Pygospio elegans*.

Keywords: Arctic, glandular organ, *Glyphochaeta gen. n.*, *Glyphochaeta laudieni sp. n.*, grooved spine, Kongsfjorden, Polychaeta, Spionidae, Spitsbergen

Introduction

The “Spionidae” Grube, 1850 as currently defined comprises 38 genera and more than 450 species (Wilson 2000; Rouse and Pleijel 2001), but it is now known to represent a paraphyletic assemblage (e.g. Blake and Arnofsky 1999; Rouse and Pleijel 2001). Features that have usually been used to characterize species within this group include the shape of the prostomium, especially the anterior margin and the posterior end (caruncle); the length and shape of the nuchal organ or dorsal sense organ; the number of branchiae, their distribution and the degree of fusion of branchiae with postchaetal notopodial lamellae; the distribution and form of hooded hooks, as well as the number of anal cirri or lobes. In addition, some genera are clearly characterized by strongly modified neuro- or notochaetae anteriorly or posteriorly, e.g. species of the *Polydora* and *Atherospio* (*sensu* Mackie 1996) complexes, *Australospio* Blake and Kudenov, 1978, *Lindaspio* Blake and Maciolek, 1992, *Scolecopides* Ehlers, 1907, *Spiophanes* Grube, 1860, and *Xandaros* Maciolek, 1981. In most cases the function of these modified chaetae remains to be clarified.

Correspondence: Andreas Bick, Universität Rostock, FB Biowissenschaften, Allgemeine and Spezielle Zoologie, Universitätsplatz 2, D-18051 Rostock, Germany. Email: andreas.bick@uni-rostock.de

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Investigations of the intertidal and shallow subtidal polychaete fauna of the Kongsfjorden, Spitsbergen, yielded about 20 specimens belonging to the “Spionidae”. These specimens all belong to the same species, which differs from all other spionids in having grooved chaetae in some neuropodia of the middle body region. These modified chaetae are grooved spines and are associated with glandular organs of the corresponding chaetigers. Based on this character, a new genus and species of “Spionidae” is described.

Material and methods

The specimens were collected in a marine grotto near Hansneset (78°59.08'N, 11°57.43'E) Blomstrandhalvøya, in the Kongsfjorden, Spitsbergen, between colonies of unidentified Bryozoa. The grotto is about 8 m wide and 15 m long, the opening is partially above the sea level. The water depth in the entrance of the grotto is about 6 m and in the back about 3 m. The light gradient is a major factor determining the hard bottom community here: the macroalgae *Laminaria solidungula* Agardh, 1868, *Phycodrys rubens* (Linnaeus) Batters, 1902, and *Ptilota plumosa* (Hudson) Agardh, 1868 dominate in the entrance of the grotto, whereas mainly sponges (*Halichondria panicea* (Pallas, 1766), *H. genitrix* (Schmidt, 1870), *Haliclona viscosa* (Topsent, 1888), *Grantia utriculus* (Schmidt, 1869), and *Suberites ficus* (Johnston, 1842)), but also the ascidian *Halocynthia* sp., the nephtheid soft coral *Gersemia rubiformis* (Ehrenberg, 1834) and Bryozoa occur in the back. The echinoderms *Strongylocentrotus droebachiensis* (O. F. Müller, 1776) and *Henricia sanguinolenta* (O. F. Müller, 1776) were also found on the wall of the grotto. The Kongsfjorden is an Arctic glacier fjord, influenced by tides (tidal range 1.5–2.0 m), bound by rocky shores, and covered by ice during the winter season. Since freshwater from glaciers and snowfields enters the shallow coastal areas at several places, brackish water overlies the marine water in summer. The salinity on the surface was between 5 and 10 psu, and between 30 and 34 psu near the bottom. More information about this fjord is given by Svendsen et al. (2002) and Hop et al. (2002). The Bryozoa colonies were scraped off from the cave wall by scuba divers at a depth between 3 and 4 m. The Bryozoa colonies and the associated fauna were preserved in a 4% formaldehyde–seawater solution. In the laboratory, samples were washed and sieved through a 0.5 mm screen. The unknown spionids and the other polychaetes were picked out under a dissecting microscope at 10–15× magnification. Methyl green staining was employed to visualize body structures. Drawings were made using a microscope and drawing attachment. For SEM 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. For histological investigations of the glandular organ, samples were infiltrated and embedded in Araldite after dehydration. Sections with a thickness of about 1 µm were cut using a Leica Reichert Ultracut S ultramicrotome and subsequently stained in a solution modified after Richardson et al. (1960). Micrographs were taken with a Zeiss-Axioplan microscope and a CCD-camera ProgRes C10 (Jenoptik). Type material has been deposited in the Zoologische Sammlung der Universität Rostock (ZSRO); catalogue numbers are given below.

Systematics

Family SPIONIDAE Grube, 1850

Glyphochaeta gen. nov.

Type species: *Glyphochaeta laudieni* sp. nov.

Gender: Feminine.

Diagnosis

Body not clearly divided in different regions. Anterior margin of prostomium with frontal horns; posterior end forming a short caruncle extending to chaetiger 1; without occipital antenna; eyes present. Nuchal organ as small ciliated patch on the posterior margin of the prostomium. Peristomium well developed. Branchiae absent. Postchaetal lamellae well developed only in the anterior body region. Mid-segmental dorsal ciliated crest present. Lateral organs absent. Notopodia with capillaries. Anterior neuropodia with capillaries; neuropodia of the middle and posterior body region with hooded hooks, replaced by grooved spines in some neuropodia of the middle body region. Some chaetigers of the middle body region with glandular organs. Sabre chaetae absent. Pygidium with four anal lobes.

Etymology

The generic name refers to the shape of the grooved spines that replace the hooded hooks in some neuropodia of the middle body region (*glyphanos*—Greek for a carving tool or chisel; *chaite*—Greek for bristle).

***Glyphochaeta laudieni* sp. nov.**

(Figures 1–3)

Type material

Holotype: Svalbard, Spitsbergen, Kongsfjorden, Blomstrandhalvøya, marine grotto near Hansneset (78°59.08'N, 11°57.43'E), grotto wall, from among Bryozoa colonies, 4 m depth, 4 September 2004 (ZSRO-P1649). Paratypes: Svalbard, Spitsbergen, Kongsfjorden, Blomstrandhalvøya, marine grotto near Hansneset (78°59.08'N, 11°57.43'E), grotto wall, from among Bryozoa colonies, 4 m depth, 4 September 2004, four specimens (ZSRO-P1650); Svalbard, Spitsbergen, Kongsfjorden, Blomstrandhalvøya, marine grotto near Hansneset (78°59.08'N, 11°57.43'E), grotto wall, from among Bryozoa colonies, 3.5 m depth, 21 June 2003, three specimens (ZSRO-P1651); Svalbard, Spitsbergen, Kongsfjorden, Blomstrandhalvøya, marine grotto near Hansneset (78°59.08'N, 11°57.43'E), grotto wall, from among Bryozoa colonies, 4 m depth, 21 June 2003, 13 specimens (ZSRO-P1652).

Description

Holotype complete with 35 chaetigers, total length 3.3 mm, width 0.4 mm. Paratypes between 0.8 and 4.1 mm long and 0.37 and 0.54 mm wide, with 18–35 chaetigers. Prostomium with frontal horns anteriorly, with four eyes trapeziformly arranged with posterior pair smaller and usually more closely spaced (Figures 1A, 2A); occipital antenna absent; prostomium terminating posteriorly in a small caruncle extending to the middle/end of chaetiger 1; palps relatively short, extending at most to chaetiger 10 in preserved specimens. Very small nuchal organ as ciliated patches at the posterior margin of the prostomium (Figures 1A, 2A). Body not distinctly divided in different regions, with transversal ciliated crests dorsally and smooth surface ventrally (Figure 2B). Mid-segmental ciliated crest from chaetiger 2 to about chaetiger 10, thereafter ciliated crest at the posterior margin of chaetigers. Branchiae completely absent. Lateral organs absent. Postchaetal

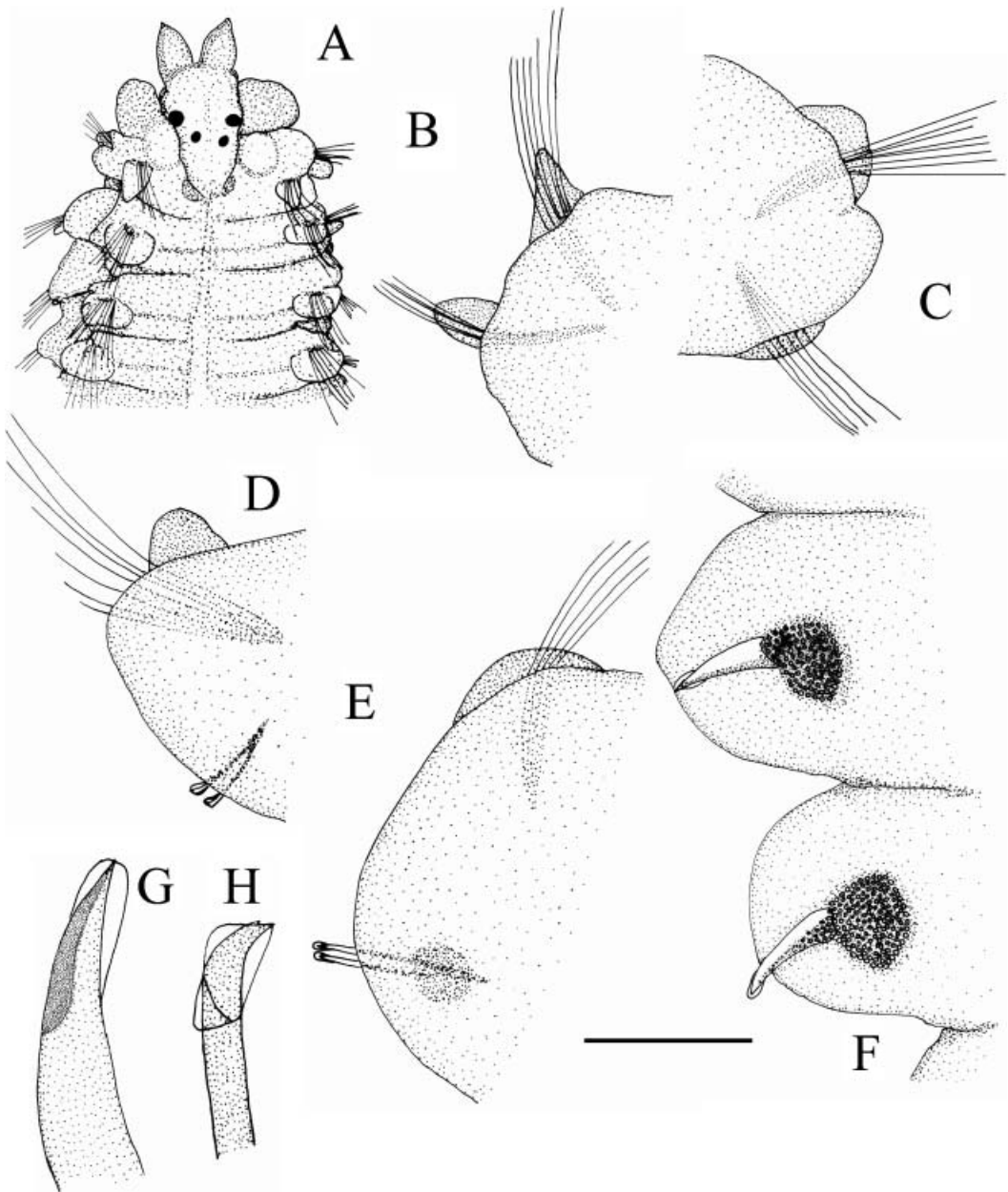
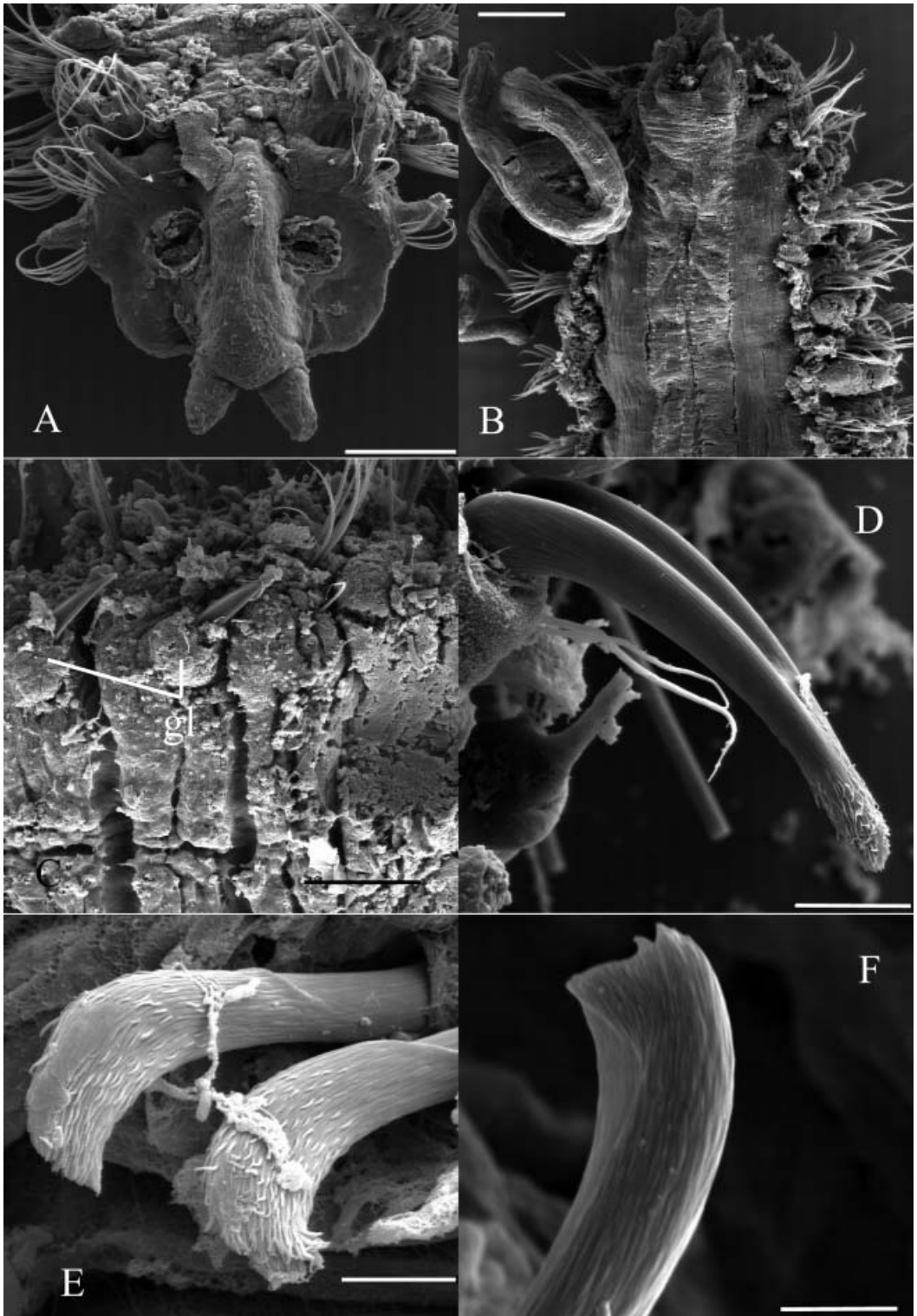


Figure 1. *Glyphochaeta laudieni* gen sp. n. (A) Anterior end, dorsal view, palps broken off; (B) first chaetiger, anterior view; (C) chaetiger 10, anterior view; (D) chaetiger 12, anterior view; (E) chaetiger 15, anterior view; (F) chaetiger 16 and 17, ventral view; (G) grooved spine from chaetiger 14; (H) hooded hook from posterior chaetiger. Scale bar: 200 μ m (A); 100 μ m (B–F); 20 μ m (G, H).

Figure 2. *Glyphochaeta laudieni* gen sp. n., SEM micrographs. (A) Anterior end, frontal view; (B) anterior end, ventral view; (C) lateral view of chaetigers 12–15, neuropodial hooded hooks of chaetiger 12 and 13 broken off; (D) grooved spine of chaetiger 16; (E) neuropodial hooded hooks of a posterior chaetiger; (F) neuropodial hooded hook of a posterior chaetiger, two apical teeth above the main tooth. Scale bars: 60 μ m (A, C); 100 μ m (B); 10 μ m (D); 4 μ m (E); 3 μ m (F).



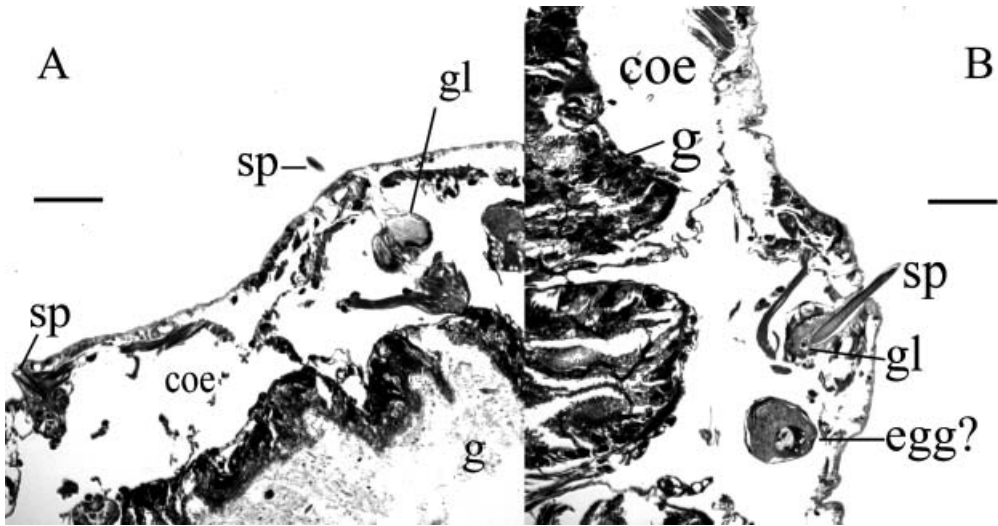


Figure 3. *Glyphochaeta laudieni* gen sp. n., light micrographs. (A) Sagittal section through chaetiger 14 and 15 with glandular organ in chaetiger 14 and grooved spine in chaetiger 15; (B) sagittal section through chaetiger 14 with glandular organ associated with grooved spine. Scale bars: 30 μ m. coe, coelom; g, gut; gl, glandular organ; sp, grooved spine.

lamellae present; on chaetiger 1 tongue-like (Figure 1B); thereafter, notopodial lamella first triangular, later broadly rounded (Figure 1C–E), absent posteriorly; neuropodial lamella broadly rounded, absent when hooks appear (Figure 1C–E). Notopodia with smooth or hirsute capillaries, usually in two rows. Anterior neuropodia with smooth or hirsute capillaries, from chaetiger 8 or 9 in juveniles and from chaetiger 11 or 12 in adults additionally one or two hooded hooks (Figures 1H, 2E), usually only slightly bent, uni- or bidentate (Figure 1H); with appearance of hooks, the number of capillaries decreases considerably, one or two capillaries up to chaetiger 14 at most, in posterior chaetigers two or three neuropodial hooded hooks, uni-, bi- or sometimes tridentate (Figure 2F); spines, with longitudinal groove basally (Figures 1F, G, 2C, D) first appear on chaetiger 14 on specimens with more than 28 chaetigers in total (one specimen with 33 chaetigers without spines as an exception), only one grooved spine per neuropodium present, grooved spines replace hooded hooks from chaetiger 14 up to chaetiger 20, depending on total number of chaetigers (Table I), sometimes on posteriormost spine-bearing neuropodia one hooded hook present additionally; spines are 10–12 μ m in diameter at the very base, posterior spines sometimes thinner; grooved spines associated with glandular organs (Figures 1F, 2C, 3B). Glandular organs about 25–35 μ m in diameter (Figure 3A, B). Sabre chaetae (recurved chaetae with a broad blade in the ventralmost position of the neuropodia) absent. Pygidium with four anal lobes, maximum about 58 μ m in length. No discernible methyl green or Shirlastain A[®] staining pattern.

Additional observations

The hooded hooks and spines are sometimes asymmetrically arranged. For example, hooded hooks are first present only on one side of the body, whereas the corresponding neuropodium of the other side still bears capillaries. In other cases, spines may be

Table I. *Glyphochaeta laudieni* gen sp. n.: ranges of numerical characters for different specimens.

| | | Number of chaetigers | Length (mm) | First chaetiger(s) with hooded hooks (capillaries still present) | First chaetiger with hooded hooks only | Chaetigers with grooved spines | Length of anal lobes (µm) |
|------------|-------------------|----------------------|-------------|--|--|--------------------------------|---------------------------|
| ZSRO-P1649 | Holotype | 35 | 3.2 | 12 | 13 | 14–16 | n.m. |
| ZSRO-P1650 | Paratypes | 18 | 1.1 | 8 | 10 | – | 32 |
| | | 25 | 1.5 | 10 | 11 | – | 45 |
| | | 33 | 2.5 | 11–12 | 13 | – | 48 |
| | Anterior fragment | ? | ? | 9 | 10 | 14 | – |
| ZSRO-P1651 | Paratypes | 35 | 4.1 | 11–13 | | 14–18 | n.m. |
| | Anterior fragment | ? | ? | 12–13 | | 14–20 | – |
| | Anterior fragment | ? | ? | 12–13 | | 14–17 | – |
| ZSRO-P1652 | Paratypes | 18 | 0.8 | 11–12 | | – | – |
| | | 22 | 1.0 | 9–11 | 12 | – | – |
| | | 24 | n.m. | 11 | | – | – |
| | | 28 | 2.1 | 11–13 | | 14–16 | – |
| | | 32 | 2.2 | 11–13 | | 14–17 | 58 |
| | | 34 | 2.1 | 11–13 | | 14–17 | 58 |

n.m., Not measured.

developed in some neuropodia, whereas hooded hooks are present on the corresponding neuropodia of the other side.

Etymology

The species is dedicated to Dr Jürgen Laudien of the Alfred-Wegener-Institut Bremerhaven. He collected some of the specimens and he assisted us greatly during our field investigations on Spitsbergen in June 2003.

Geographical distribution

Species known only from the type locality.

Discussion

Glyphochaeta laudieni sp. n. is unique among “Spionidae” in having grooved spines connected with glandular organs in some middle neuropodia (Figures 1F, 2C, D, 3B). The position of the species within the “Spionidae”, however, is not clear. *Glyphochaeta* shares the absence of branchiae within “Spionidae”—as currently defined (excluding Apistobranchidae, Longosomatidae, Poecilochaetidae, Trochochaetidae, and Uncispionidae)—only with *Spiophanes*. Moreover, large parapodial glandular organs in the middle body region are present only in *Glyphochaeta* and *Spiophanes*. In *Spiophanes* these glandular organs are present from chaetiger 5 to about chaetiger 13–15 (Meißner and Hutchings 2003), whereas in *Glyphochaeta* they first appear from chaetiger 14. The structure of these glands is completely different as well. In *Spiophanes* the glandular organs

producing “bacillary chaetae” are mainly composed of a large glandular sac and an accessory gland taking up almost the whole chaetiger (unpublished data), whereas in *Glyphochaeta* the glands are restricted to the neuropodia (Figure 3). In *Glyphochaeta* the glands probably produce a liquid secretion, and the attached grooved spines may act as a moving open drain (Figures 1F, 2C, D, 3B). A potential convergent development of glandular organs and a convergent reduction of branchiae in *Spiophanes* and *Glyphochaeta* cannot be excluded. Most characters mentioned in the diagnosis of *Spiophanes* provided by Meißner and Hutchings (2003) are absent in *Glyphochaeta*.

Comparable glandular organs have also been described in other species of spionids, for examples the “poches glanduleuses” in *Polydora* (Claparède 1870), the “podialen Drüsenorgane” in *Microspio*, *Pygospio*, and *Spio* (Söderström 1920), or the glands in the fifth chaetiger of juvenile *Polydora ciliata* (Johnston, 1838) (Hannerz 1956). These glands are usually smaller than those found in *Spiophanes* or *Glyphochaeta*, but they are also connected with neuropodial chaetae as in *Glyphochaeta* (except for *P. ciliata*). Comparative studies into homologies of the glandular structures in spionids remain to be performed.

The function of the grooved spine as a drain seems apparent, yet the function of the secretion is obscure. The specimens were found only in samples with colonies of Bryozoa. The samples from the bottom of the grotto with a high amount of detritus never contained *G. laudieni* sp. n. All specimens were found free in the samples, without any indication of a tube, so that this gland is probably not involved in formation of a tube. This assumption is reinforced by the absence of spines in juvenile specimens. Spines first appear when about 28 chaetigers have been developed (Table I). The presence of spines in adults may indicate a reproductive function. The small size of the species points to a low number of larvae and a lecithotrophic or direct development, although this hypothesis remains to be tested.

The appearance and the shape of hooded hooks have been regularly used in taxonomic descriptions. The first appearance of hooks in juveniles is most important for phylogenetic analyses. It has already been used in the cladistic analysis of *Prionospio* and related genera (Sigvaldadóttir 1998). The first appearance of hooks is often invariable (e.g. *Polydora* complex, *Pygospio*, *Streblospio*), but in other cases their presence depends to a certain extent on the total number of chaetigers (and it is only useful for identification at best, e.g. *Marenzelleria*, *Prionospio*, *Spio*). In *G. laudieni* sp. n. the hooded hooks first appear on chaetiger 8 or 9 in the smallest specimens but in chaetiger 11–12 in adults; thus, as the individuals grow, the first hooks become displaced two to four chaetigers backwards. This minor shift of hooks is probably the most common case among spionids. The first appearance of neuropodial hooded hooks at chaetiger 8 is not unusual: it has been recorded for example in certain genera of the *Polydora* complex and in some species of *Pygospio* and *Streblospio*. Interesting in this context is that Söderström (1920) described a transformation of bidentate hooded hooks into spoon-like hooks (“löffelförmige Borsten”) in the neuropodia of chaetigers 8–11 of mature *P. elegans* Claparède, 1863. This transformation was also described by Berkeley and Berkeley (1954) from a single specimen from Nova Scotia and by Light (1977) from specimens from California. The California specimens exhibit spoon-like hooks in chaetiger 8 through to chaetiger 10 or 12. Hilbig (1982) provided SEM micrographs of these spoon-like hooks. The hooks possess a groove on the concave side; hoods are still present, but the hood may be opened at the concave side of the hook. Adult *P. elegans* from the Baltic Sea also possess these modified hooded hooks (personal observation). Some of these hooks resemble those described for *P. elegans* by Söderström (1920), whereas others resemble those found on species of the *Atherospio* complex (*sensu* Mackie 1996) (personal observation). The transformation of hooded hooks

parallels that found in *G. laudieni*, because already Söderström (1920) concluded that the development of the spoon-like hooks was a function of age and that they derived from a transformation of the bidentate hooded hooks as the specimens matured. In *Glyphochaeta*, however, the hooded hooks of chaetiger 14 and subsequent chaetigers are replaced by grooved spines without a conspicuous hood (Figure 2D), and the spines are a great deal thicker. Additional similarities with *P. elegans* are the absence of sabre chaetae, the presence of neuropodial glands, and the number and shape of anal cirri. Therefore, an assignment of *Glyphochaeta* into the third group (with *P. elegans*, the *Atherospio* complex, and *Pseudopolydora primigenia* Blake, 1983) of the strict consensus tree provided by Mackie (1996) is most likely.

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