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A new species of *Streptospinigera* Kudenov, 1983 (Polychaeta, Syllidae, Anoplosyllinae) from the Arctic and north-western Atlantic with a key to all species of the genus

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Abstract Since 2007, the ArcticNet and CHOne programmes have allowed researchers, through oceanographic surveys on the ‘NGCC Amundsen’, to collect yearly benthic samples in the Canadian High Arctic. From the Beaufort Sea to the Bay of Baffin, more than 262 samples have been collected and analysed to provide essential data to explain patterns of biodiversity in the Canadian Arctic archipelago. Whereas common species are well known, other more rare species belonging to a few minute species groups, with debatable taxonomy, were set aside for further analyses. Focusing on Syllidae (Annelida, Polychaeta), we found and describe here *Streptospinigeraniuqtuut* sp. nov. from muddy habitats of bathyal Arctic and continental slope beds of northern Atlantic coasts of United States between depths of 169 and 707 m. *S. niuqtuut* differs from congeneric species by unique dorsal simple chaetae of 1–5 chaetigers dorsally curved and distally rounded, with some sub-distal serration. This species may have frequently been reported from the region as *Syllides longocirrata* Ørsted 1845 but in fact are species of the genus *Streptospinigera*

Kudenov 1983. We also transfer *Streptosyllis templadoi* San Martín 1984 to this genus and provide herein a key for the identification of all species of the genus.

Keywords Polychaeta · Syllidae · Anoplosyllinae · *Streptospinigera* · Arctic · *Syllides longocirrata* · Gulf of Maine

Introduction

Since 2007, the ArcticNet programme has allowed researchers from the CHOne Network (Canadian Healthy Oceans Network; Snelgrove et al. 2012), through oceanographic surveys on the ‘NGCC Amundsen’, to collect yearly benthic samples in the Canadian high Arctic. From the Beaufort Sea to the Baffin Bay, more than 262 samples have been collected and analysed to provide essential data to describe and explain patterns of biodiversity in the Canadian archipelago (Archambault et al. 2010; Link et al. 2011; Piepenburg et al. 2011). Whereas common species are well known, other more rare species belonging to a few minute species groups, with debatable taxonomy, were set aside for more in-depth analyses. In that context, the current paper focuses on samples of Syllids (Annelida, Polychaeta) because they constitute one of the most diverse families of Polychaeta, with more than 74 genera and around 700 valid species (Aguado and San Martín 2009; San Martín 2003). We found 11 specimens of one new species of the genus *Streptospinigera* Kudenov 1983 largely reported heretofore as *Syllides longocirrata* Ørsted 1845. Because there could be considerable confusion with this last species, we also examined specimens originating from the Gulf of Maine and found that they too belong to the same species. The aim of the present paper is therefore

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to describe *Streptospinigeraniuqtuut* sp. nov. from muddy habitats of bathyal Arctic and continental slope beds of northern Atlantic coasts of United States. We also transfer *Streptosyllis templadoi* San Martín 1984 to this genus and provide herein a key for identification of worldwide species of the genus.

Materials and methods

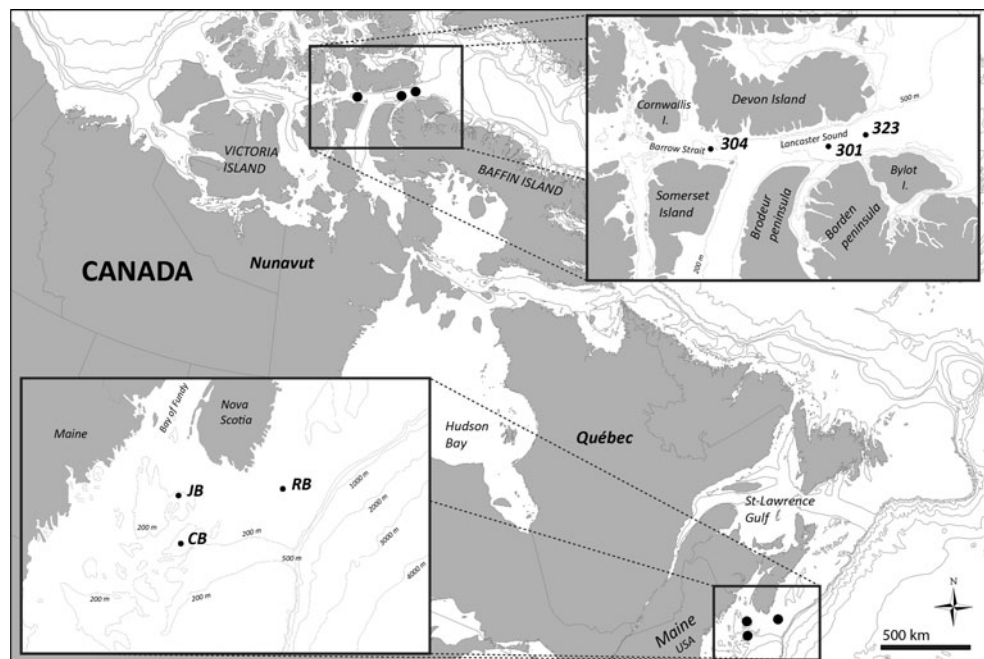
A collection of over 25 specimens from ArcticNet (Stations 301, 304 and 323; Table 1) and Gulf of Maine (Stations JB03, JB04, RB01, RB02 and CB02; Table 1) subtidal stations (Canada Archipelago and eastern USA, Fig. 1) was

examined. Specimens were obtained from ten benthic samples collected by using either a Box-corer (ArcticNet surveys from 2008, 2009 and 2011; 'CCGS *Amundsen*') or a multi-corer (Gulf of Maine surveys from 27 July to 12 August 2009; 'CCGS *Hudson*'). Sediment samples were sieved on either 0.3 mm (Gulf of Maine) or 0.5 mm (Canadian Arctic) square meshes, and the retained material fixed in 5 % buffered formalin. Most samples were sorted in the laboratory and specimens preserved in 70 % ethanol. However, 1 living specimen that was collected during the 2011 Arcticnet campaign (complementary surficial sediment samples sieved on a 0.5 mm mesh) by first author was directly preserved in 95 % ethanol and constitutes the holotype.

Table 1 Locations, geographical coordinates, depth, stations codes, sampling dates, samplers, mesh sizes, sediment types, temperature and salinity where the new species was collected

Location	Coordinates (WGS84)	Depth (m)	Station code	Sampling date	Abundance (ind.)	Sampler	Sieve (mm)	Sediment	T (°C)/S (ppm)
Canadian archipelago	74°09.18N82°12.53W	707	301	08/09/2008	2	Box-core	0.5	Silt	1.3/33.8
Canadian archipelago	74°06.14N83°22.60W	669	301	14/10/2011	1	Box-core	0.5	Silt	0/34.0
Canadian archipelago	74°16.28N91°14.85W	353	304	06/09/2008	4	Box-core	0.5	Silt	0.1/34.5
Canadian archipelago	74°19.06N91°24.38W	331	304	23/10/2009	3	Box-core	0.5	Silt	−0.1/33.9
Canadian archipelago	74°10.35N80°43.55W	786	323	25/10/2009	1	Box-core	0.5	Silt	1.3/34.5
Gulf of Maine	43°32.47N67°04.74W	214	JB03	27/07–12/08 2009	3	Multi-corer	0.3	Silt	0–4/~34
Gulf of Maine	43°19.81N67°10.76W	244	JB04	27/07–12/08 2009	1	Multi-corer	0.3	Silt	0–4/~34
Gulf of Maine	43°10.67N65°04.58W	175	RB01	27/07–12/08 2009	3	Multi-corer	0.3	Silt	0–4/~34
Gulf of Maine	42°58.12N65°10.44W	169	RB02	27/07–12/08 2009	4	Multi-corer	0.3	Silt	0–4/~34
Gulf of Maine	42°53.90N67°26.35W	243	CB02	27/07–12/08 2009	5	Multi-corer	0.3	Silt	0–4/~34

Fig. 1 Distribution of *S. niuqtuut* sp. nov. in the studied region, Stations 301, 304 and 323 correspond to ArcticNet benthic explorations (2007–2011) and CB (Crowell Basin), JB (Jordan Basin) and RB (Rosemary Basin) to GoMA (Census of Marine Life) 2009 surveys



Drawings were made to scale with a camera lucida drawing tube attached to a Nikon Optiphotopic microscope equipped with interference contrast optics (Nomarsky). One paratype selected for scanning electron microscopy (SEM) was critical point dried and subsequently coated with 102 Å of gold. It was examined with a Philips XL30 electron microscope connected to an EDAX DX4i analyzer at SIDI (Servicio Interdepartamental de Investigación), Universidad Autónoma de Madrid (UAM). Width of the specimen, excluding parapodia, was measured at the proventricle level.

Family SYLLIDAE Grube, 1850

Subfamily ANOPLOSYLLINAE Aguado and San Martín, 2009

Genus *Streptospinigera* Kudenov, 1983: 84–85.

Type-species: *Streptospinigera heteroseta* Kudenov 1983

Diagnosis: Body small to medium size, with 23–44 chaetigers. Prostomium with 2 pairs of eyes and, sometimes, one pair of eyespots. Three antennae. Palps fused basally, distally rounded, blunt. Nuchal organs as 2 ciliated grooves between prostomium and peristomium. Two pairs of tentacular cirri. Antennae, tentacular cirri and anterior dorsal cirri smooth, club-shaped, smooth and elongated on midbody; all cirri smooth or abruptly becoming annulated from midbody to posterior parapodia or alternating between smooth and annulated. Parapodial lobes distally beak-shaped to truncate, anterior ones twice as thick as others. On anterior segments, ventral cirri short, broad, more or less bulbous, not extending beyond parapodial lobes; remaining ventral cirri digitiform, elongated, sometimes exceeding beyond parapodial lobes. Compound chaetae with falcigers and spiniger-like chaetae on same parapodium. Blades of falcigers thick on some anterior parapodia, abruptly becoming slender thereafter. Dorsal simple chaetae present from anterior parapodia, distally curved, thick on anterior parapodia, abruptly becoming slender, capillary; ventral simple chaetae absent. Pygidium with 1 midventral and 2 dorsolateral anal cirri. Pharynx unarmed. Reproduction by epigamy.

Remarks: The most distinctive character of this genus is the strong and abrupt difference between the shape of dorsal simple chaetae, compound chaetae, parapodia and ventral cirri, of some anterior segments to remaining ones. In addition, the presence of spiniger-like chaetae and of some distally enlarged aciculae in some anterior parapodia is very specific.

Streptospinigera niuqtuut sp. nov.

Syllides longocirrata non Ørsted 1845, Webster & Benedict (1887): 717, Fig. 2–6. Eliason (1962): 241,

Fig. 10 a–f. Banse (1971): 1470, Fig. 1 a–l. Hartmann-Schröder (1996): 166, Fig. 71.

Material examined: [ArcticNet (Stations 301, 304, 323) and Gulf of Maine (Stations JB, RB, CB), Fig. 1, Table 1; $n = 25$].

Holotypes and paratypes of *S. niuqtuut*, collected from Barrow Strait and Lancaster Sound (Canadian High Arctic Archipelago, Fig. 1), have been deposited in the collections of the Muséum National d'Histoire Naturelle (Paris, France) (holotype MNHN POLY TYPE 1553 and 3 paratypes MNHN POLY TYPE 1554), of the Canadian Museum of Nature (Ottawa, Canada) (1 paratype CMNA

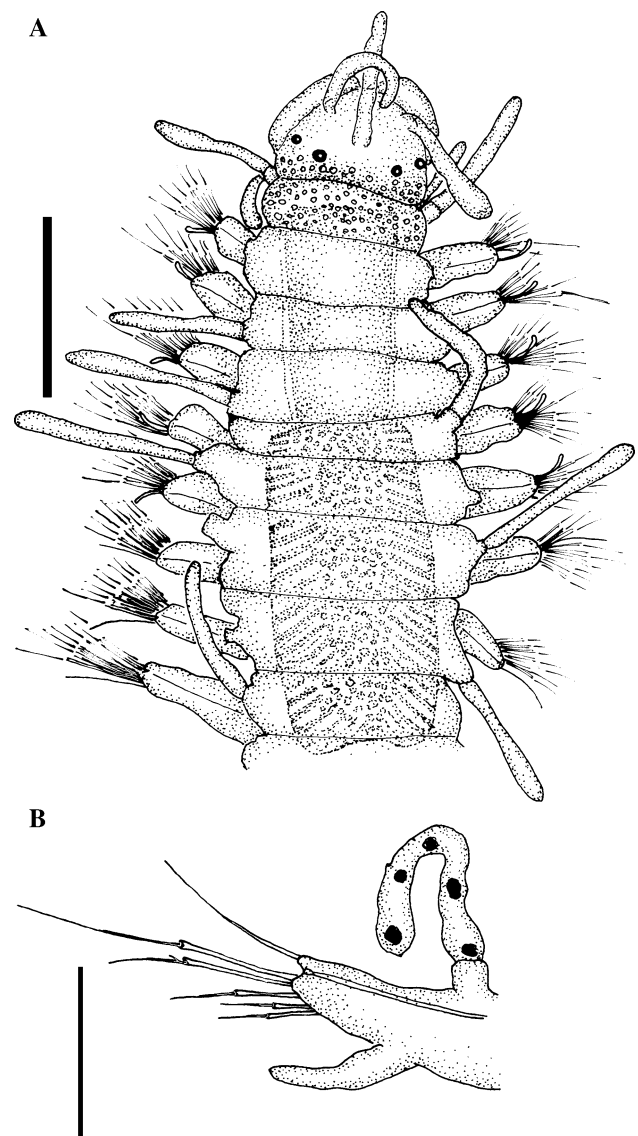


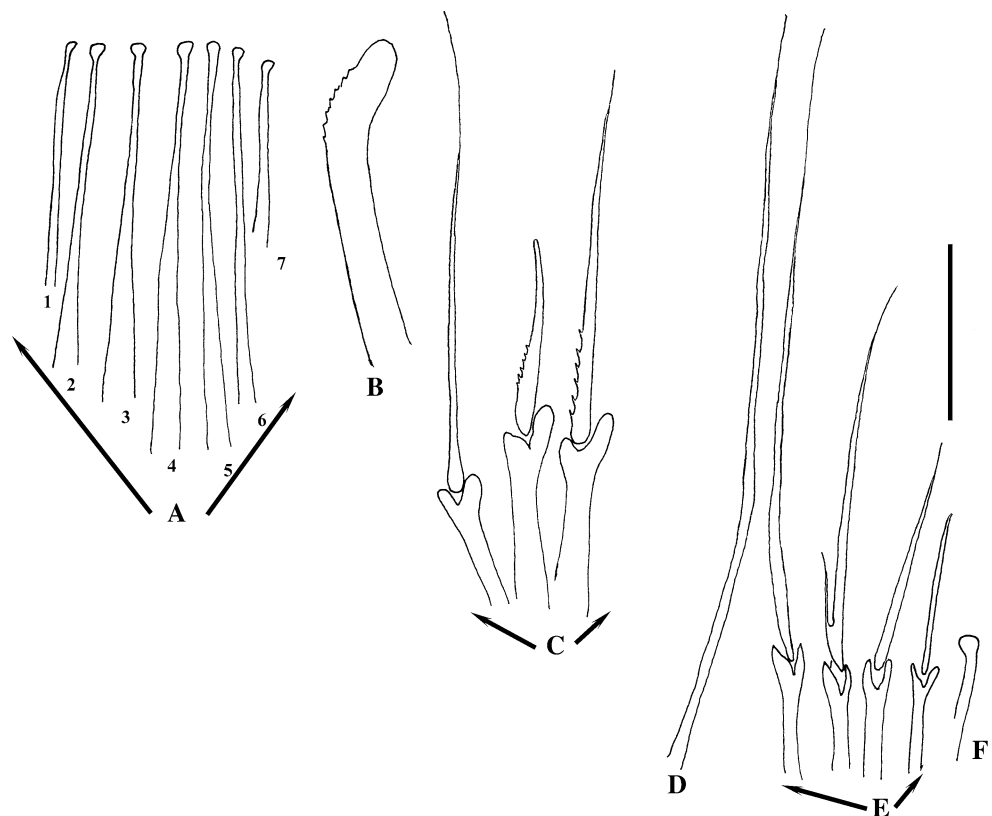
Fig. 2 *S. niuqtuut* sp. nov. Holotype (MNHN POLY TYPE 1553). **a** Anterior end, dorsal view. **b** Midbody parapodium (only shown one of each pair of chaetae). Scale: **a** 0.2 mm. **b** 0.1 mm

2013-0001) and of the Museo Nacional de Ciencias Naturales (Madrid, Spain) (1 paratype MNCN 16.01/14334 and SEM stub MNCN 16.01/14334).

Description: Body small, fragile; longest specimen examined 3 mm long, 0.4 mm wide, 44 chaetigers. Holotype incomplete female developing oocytes, 1.9 mm long, 0.3 mm wide, 19 chaetigers. Prostomium sub-pentagonal, with 4 eyes in open trapezoidal arrangement; palps broad, short, basally fused, without medial scar. Antennae relatively short, club-shaped, smooth; median antenna inserted between anterior eyes, similar in length to prostomium and palps together; lateral antennae similar in shape, slightly shorter than median antenna, inserted near anterior margin of prostomium. Peristomium well defined, similar to subsequent segments, densely provided with brown/orange, iridescent granules, extended from half of prostomium (Figs. 2a, 4a, 5a, b). Dorsal tentacular cirri morphologically similar to antennae but almost twice as long as ventral tentacular cirri (Figs. 2a, 4a, arrows 1, 2). Segments well marked, with distinct intersegmental constrictions (Fig. 2a), especially on anterior segments (Fig. 5a, b). One transversal line of protuberances on dorsum of each segment (Fig. 5c), open by minute pores (Fig. 5d), probably glandular, of unknown function. Anterior parapodia broad, distally rounded, with ventral cirri ovoid (Fig. 4a, arrow 3, 4d); from about chaetiger 6, parapodia elongated, conical, distally bilobed, with longer, digitiform ventral cirri

(Fig. 2a, b). Dorsal cirri club-shaped, smooth, usually shorter than body width (Fig. 2a), detached in numerous segments on all specimens; some dorsal cirri with granular inclusions (Fig. 2b), sometimes distinctly longer than others and apparently articulated (Fig. 5e) with glands inside, open by minute pores (Fig. 5e, arrow). Bases of dorsal cirri with a tuft of cilia (Fig. 5e, f). Dorsal simple and compound chaetae of anterior-most 5 chaetigers very different from remaining ones (Fig. 2a); dorsal simple chaetae thick, curved dorsally, coarsely serrated on convex margin (Figs. 3b, 4b, 6a); compound chaetae with thick shafts, obscurely heterogomph articulation, with anterior shorter tip, pointed and rounded, than posterior one (Figs. 3c, 4c, 6b, c), blades slender, filiform, coarsely serrated basally on margin, unidentate, distally blunt, with strong dorsoventral gradation in length (around 70 μ m dorsally, 20 μ m ventrally), some blades smooth, more slender and filiform, spiniger-like, on dorsal position; about 15 compound chaetae on each anterior-most 5 parapodia. From chaetiger 6, both compound and dorsal simple chaetae abruptly different; dorsal simple chaetae slender, smooth to minutely serrated, distally blunt, with a long filiform tip (Figs. 2b, 3d, 4e, 6d, arrow); compound chaetae homogomph, with smooth, unidentate, filiform, spiniger-like blades, grouping by 4–5 per parapodium, occasionally 6 (Figs. 2b, 3e, 4d, 6e), and one, sometimes 2, chaetae with a distinct, long, basal spine (Figs. 3e, 4f, arrow, 6f), and strong

Fig. 3 *S. niuqtuut* sp. nov. Holotype (MNHN POLY TYPE 1553). **A**, aciculae of chaetigers 1–7; **b** dorsal simple chaeta, anterior body, **c** compound chaetae, anterior body, **d** dorsal simple chaeta, midbody, **e** compound chaetae, midbody, **f** acicula, midbody. Scale: 20 μ m



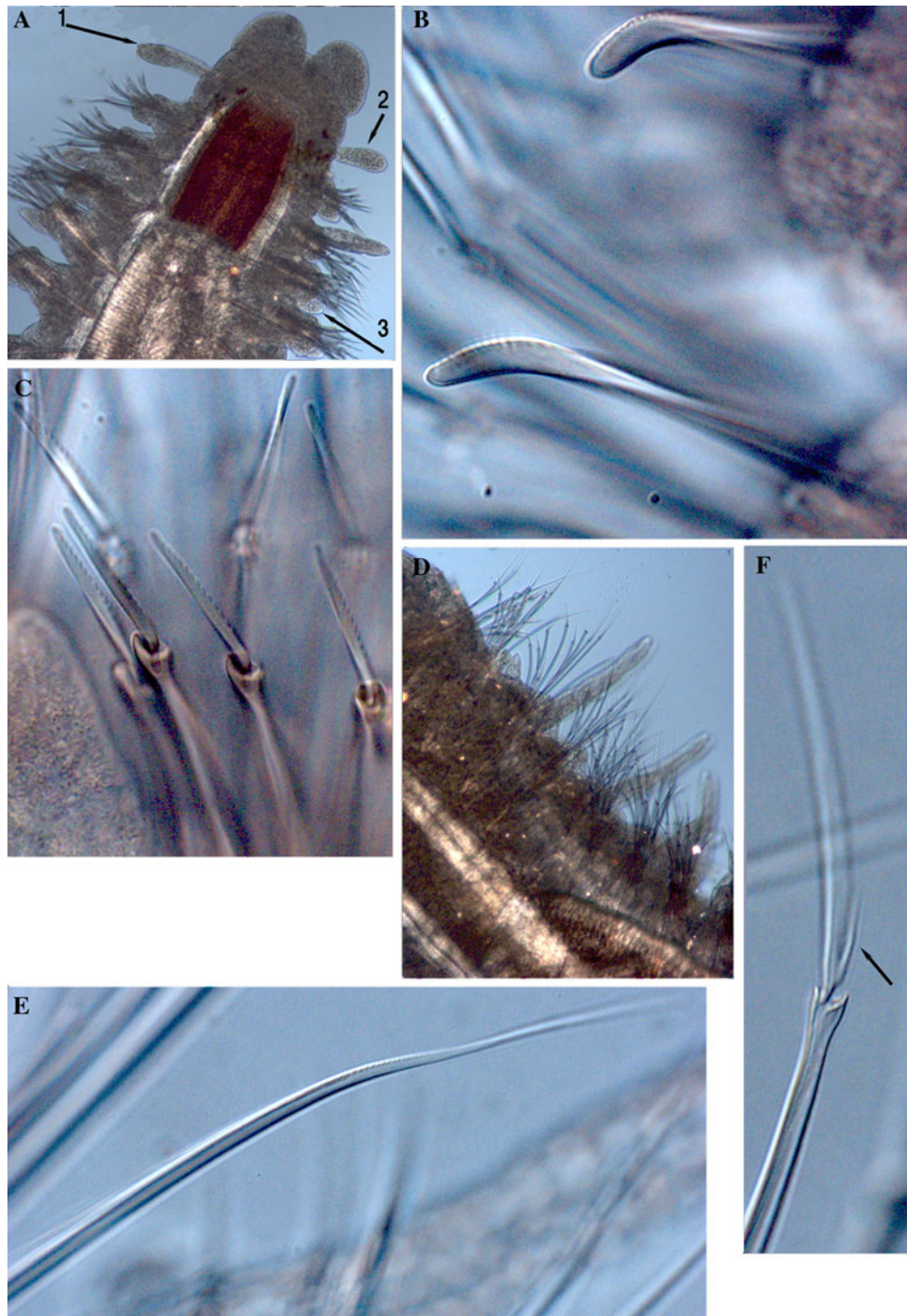


Fig. 4 *S. niuqtuut* sp. nov. Paratype (MNHN POLY TYPE 1554). Light microscope photographs ($\times 100$ or $\times 630$ magnification for body or chaetae views, respectively). **a** anterior end, dorsal view, *arrows* underlining antennae (1) and dorsal or ventral cirri (2, 3), **b** dorsal

simple chaetae, anterior parapodia, **c** compound chaetae, anterior parapodia, **d** anterior body, ventral, lateral view, **e** dorsal simple chaeta, midbody, **f** compound chaeta with long, basal spur (*arrow*), midbody

dorsoventral gradation in length (around 100 μm dorsally, 20 μm ventrally). Aciculae solitary on each parapodium, distally knobbed (Fig. 3f); those of anterior segments, from 2 to 5, distinctly longer and basally wider than remaining, those of chaetiger 6 slightly enlarged; those of chaetigers 1

and 7, similar to remaining (Figs. 3a, 3f). Pharynx through about 3–4 segments (Figs. 2a, 4a), red pigmented (Fig. 4a). Proventricle barrel-shaped (360 μm long, 200 μm width), through 5 segments, with 35 muscle cell rows, not well defined without midline of cells (Figs. 2a, 4a).

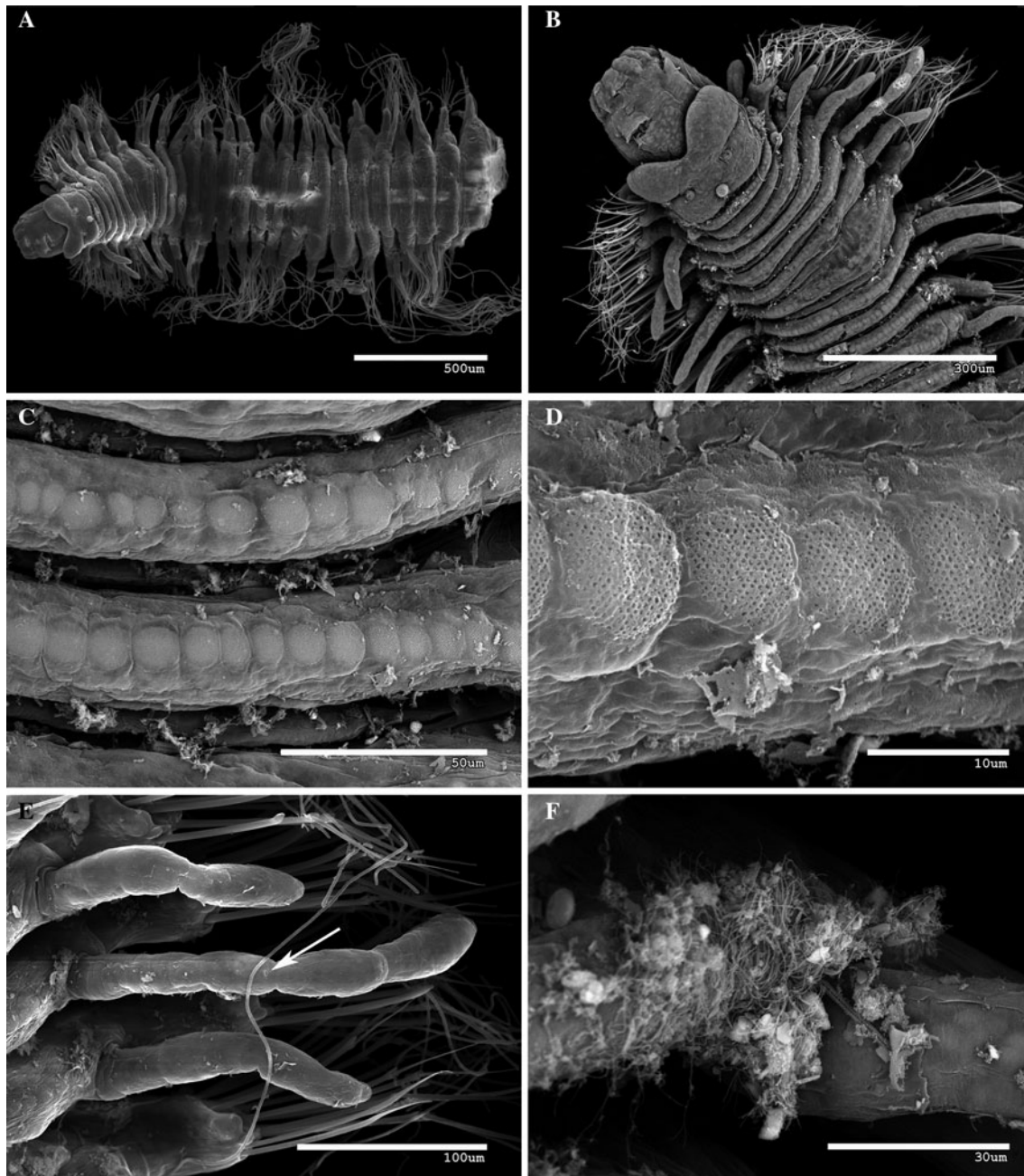


Fig. 5 *S. niuqtuut* sp. nov. SEM pictures (MNHN POLY TYPE 1554). **a** anterior end, dorsal view, epigamic male, **b** detail of prostomium and anterior segments, **c** two segments, dorsal view,

showing the lines of protuberances, **d** detail of protuberances, **e** dorsal cirri, showing a indistinctly articulated one (*arrow* pointing to pore of internal glands), **f** tuft of cilia on base of dorsal cirrus

Reproduction: One specimen epigamous, with long natatory chaetae from chaetiger 12, some others developing ovocytes and also one epigamic male with long natatory chaetae from the same chaetiger (Fig. 5a).

Habitat: Muddy sediments from 169 to 707 m depth.

Etymology: This species is named after an Inuit traditional tool, a bow drill called *niuqtuut* (ᑎᑦᑭᑦᑕᑦᑕᑦᑕ in Inuit),

because of the similarity of its shape with the unique anterior dorsal simple chaetae (<http://www.inuitcontact.ca/index.php/en/artifact/50>) and also of the sub-Arctic and Arctic distribution of this species.

Distribution: Canadian High Arctic archipelago (Barrow Strait and Lancaster Sound) and northern Atlantic coasts of United States (Gulf of Maine: Crowell, Jordan and Rosemary basins); western Sweden (Eliason 1962).

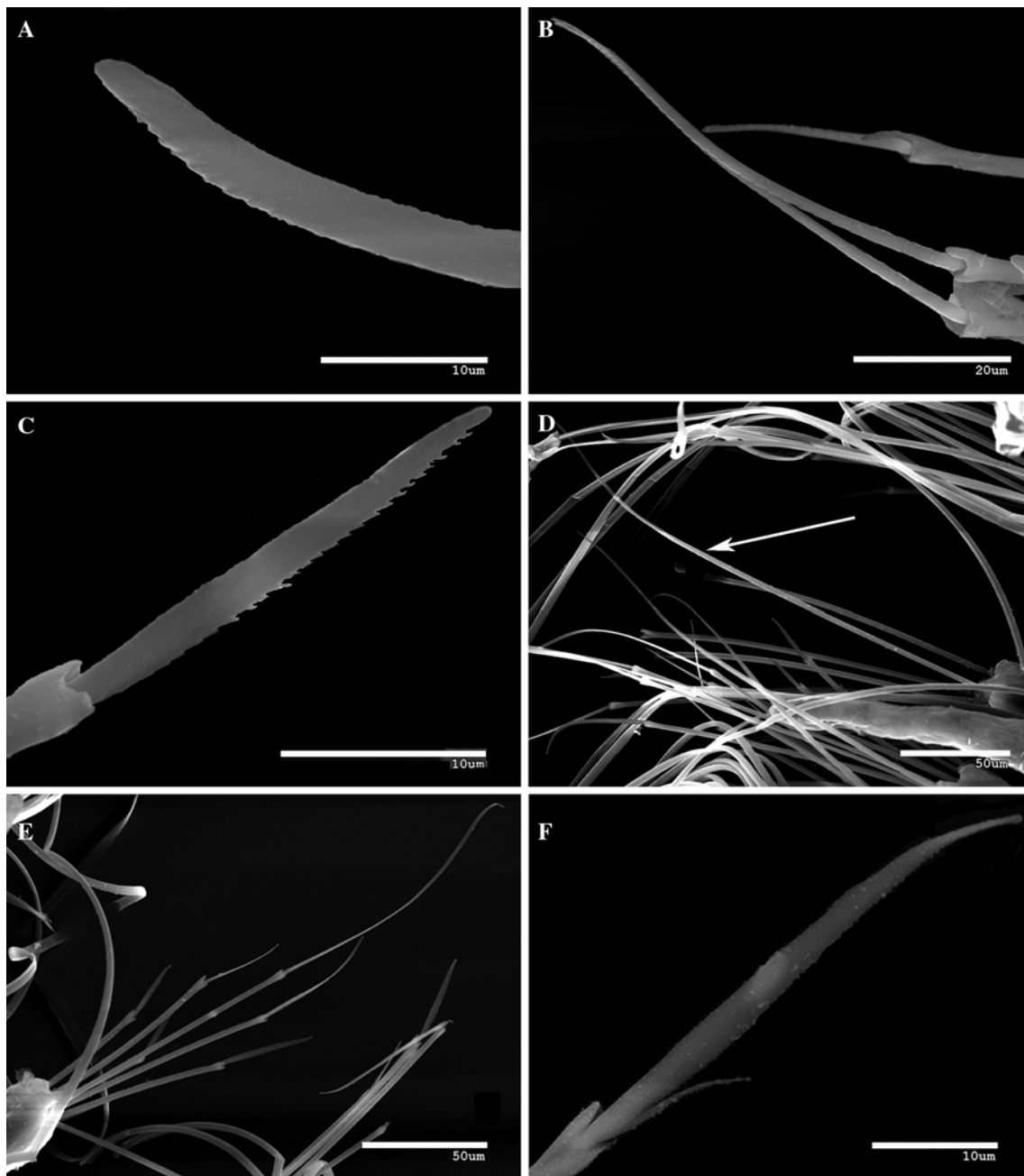


Fig. 6 *S. niuqtuut* sp. nov. SEM pictures. **a** dorsal simple chaeta, anterior segment, **b, c** compound chaetae, anterior chaetigers, **d**, dorsal simple chaeta, midbody (*arrow*), **e** a chaetal bundle, posterior, **f** compound chaeta with long basal spur

Remarks: Our specimens agree perfectly with the descriptions of *S. longocirrata* by Webster and Benedict (1887), Eliason (1962) and more recent and detailed ones by Banse (1971) and Hartmann-Schröder (1996). However, there are some differences from the original description (Ørsted 1845), in which dorsal cirri are described as ‘cirris dorsalibus longissimis articulatis’ (sic), i.e. very long, articulated dorsal cirri; all other descriptions of *Syllides longocirrata* show short, club-shaped, smooth dorsal cirri, very different from the Ørsted’s drawings, which show the

typical arrangement of dorsal cirri of the genus *Syllides* (antennae, tentacular and dorsal cirri of first two segments club-shaped, smooth and remaining dorsal cirri distinctly long and articulated); some occasional dorsal cirri of specimens described by remaining authors above mentioned, and also in our specimens, are long, with dark inclusions, seeming to be articulated; however, those long cirri do not have any particular arrangement and may even be long on one parapodium and short and club-shaped on the other parapodium of the same segment. In contrast, the

conspicuous presence of granules on the peristomium and prostomium as well as the size of proventricle are identical to the original description. At this point, it is unlikely that all these specimens are *S. longocirrata* and it would be necessary to examine the type series to positively identify them. According to Banse (1971), the type series is lost, and thus, adopting a conservative position, we cannot confirm or reject the identity of these specimens as *S. longocirrata* until material from the type locality is studied and compared to that from other localities. In this and other collections of Arctic and sub-Arctic syllids, we have found some damaged specimens which agree well with the genus *Syllides*, but the proventricle is distinctively longer, belonging perhaps to another undescribed species of that genus, but not *S. longocirrata*.

The shape and distribution of dorsal simple and compound chaetae of the species reported as *S. longocirrata* (except the original description in which there is not any figure of chaetae) are very different from those of the remaining species of the genus, but agree with those of *Streptospinigera* Kudenov 1983. There are two other known species of this genus: *Streptospinigera heteroseta* Kudenov 1983, from Florida, and *S. alternocirrus* Ohwada (1988), from Japan. Both species, as well as *S. niuquut* sp. nov., have similar compound chaetae, and the remarkable differences between the chaetae of anterior (1–5) and those of remaining parapodia and enlarged anterior aciculae. The most conspicuous difference between the 3 known species of *Streptospinigera* is the shape of the anterior, thick dorsal simple chaetae: ‘distally conical with a ventral subterminal notch and paired, lateral serrated ridges’ (sic) in *S. heteroseta* (Kudenov 1983); ‘falcate, rather short’ (sic) in *S. alternocirrus* (Ohwada 1988), both types conspicuously different to those above described for *S. niuquut* sp. nov.

Streptosyllis templadoi San Martín 1984, from the western Mediterranean and the Canary islands, also has the characters of *Streptospinigera* (San Martín 2003) and is transferred to this genus herein. This species differs from all others of the genus by having dorsal simple and compound chaetae from chaetiger 7 with a transparent hood.

Streptospinigera alternocirrus Ohwada 1988

Streptospinigera alternocirrus Ohwada 1988: 83, Figs. 1, 2.

Habitat: clean medium to fine sands.

Distribution: Japan.

Streptospinigera heteroseta Kudenov 1983

Streptospinigera heteroseta Kudenov 1983: 85, Figs. 1, 2.

Habitat: fine to very fine sand 19 m depth.

Distribution: Florida, Gulf of Mexico (USA)

Streptospinigera templadoi (San Martín 1984), n. comb.

Streptosyllis templadoi San Martín 1984: 120, pl. 20; San Martín, 2003: 121, Figs. 56–58.

Habitat: coarse to medium sand at low depths.

Distribution: Western Mediterranean and Canary Islands (Brito et al. 2000; Castelli et al. 2008).

Key to worldwide species of *Streptospinigera*

1	Dorsal simple and compound chaetae from chaetiger 7 provided with transparent hood	<i>Streptospinigera templadoi</i> (San Martín 1984), n. comb.
	Dorsal simple and compound chaetae never with transparent hood, modified chaetae only present from chaetigers 1–5	2
2	Dorsal simple chaetae of chaetigers 1–5 dorsally curved and distally rounded	<i>S. niuquut</i> sp. nov.
	Dorsal simple chaetae of chaetigers 1–5 otherwise	3
3	Dorsal simple chaetae of chaetigers 1–5 distally conical with ventral subterminal notch and paired, lateral serrated ridges	<i>Streptospinigera heteroseta</i> Kudenov 1983
	Dorsal simple chaetae of chaetigers 1–5 distally falcated, short	<i>Streptospinigera alternocirra</i> Ohwada 1988

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