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Malacoceros samurai, a new species of Spionidae (Annelida: Polychaeta) from hydrothermal vent chimney walls on the south East Pacific Rise

Stéphane Hourdez*, Daniel Desbruyères, and Lucien Laubier

(SH) Station Biologique de Roscoff, CNRS-UPMC-INSU, Place G. Teissier, 29680 Roscoff, France, e-mail: hourdez@sb-roscoff.fr;
(DD) Departement Etude des Ecosystemes Profonds (DEEP), Centre de Brest de l IFREMER, BP 70, 29280 Plouzane Cedex, France, e-mail: ddesbruy@ifremer.fr;
(LL) Centre d'Océanologie de Marseille, Station marine d'Endoume, rue de la Batterie des Lions, 13007 Marseille, France, e-mail: laubier@com.univ-mrs.fr

Abstract.—*Malacoceros samurai*, new species, (Spionidae) is described from deep-sea hydrothermal vents of the southern East Pacific Rise, at 17°25′S. It is a large species, living on chimney walls along with *Avinella* spp. Although this species is described in the genus *Malacoceros*, it possesses unidentate hooded hooks and anterior scalpel-like aristate neurosetae, both characters which clearly differentiate it from other species of the same genus. These unusual characters require the modification of the generic diagnosis of *Malacoceros*.

The Spionidae Grube, 1850 is one of the major polychaete families, presently with more than 1000 species distributed among 33 valid genera. Taxonomic studies at the level of the whole family started with Mesnil (1896), who provided the first tree of intergeneric relationships, Søderstrøm (1920), who put an emphasis on the fine structure of the teeth of the hooded hooks, then later with Hannerz (1956), who included the study of ontogenetic stages, Orrhage (1962), who focused on the anatomy and histology, and Sigvaldadóttir et al. (1997). In this last and most recent study, the phylogenetic relationships of 25 adult characteristics of type species of 28 spionid genera [all genera recognized by Blake & Kudenov (1978) plus most of those subsequently described] were examined from parsimony analyses of morphological characters. *Poecilochaetus*, *Trochochaeta*, and *Uncispio* were used as outgroups to root the analysis. The analysis indicated four equally parsimonious trees which could be reduced to two after weighting. As a result, four different groups or clades can be distinguished in the family Spionidae, i.e., *Aonidella* and *Xandaros*, *Prionospio*-complex, *Laonice*, *Spiophanes*, and *Aonides*, a large unresolved assemblage of genera, including *Polydora* (sensu lato), *Scolelepis*, *Malacoceros* and *Spio*, and *Atherospio*, *Pseudoatherospio*, and *Pygospiopsis* (Sigvaldadóttir et al. 1997). *Aonidella*, *Xandaros*, *Atherospio*, *Pseudoatherospio*, and *Pygospiopsis* were all described later than 1980. Two years later, these results were criticized by Blake & Arnofsky (1999), who considered that support for these clades was weak and that selection of outgroups was unfortunate because of the strong homology of egg and larval morphology of *Poecilochaetus* and *Trochochaeta* with other spionid genera. A new phylogenetic analysis was made by Blake & Arnofsky (1999) on the basis of larval, reproductive, and adult characters (altogether, 38 characters were

* Corresponding author.

taken into account), which allows comparison with the classifications of earlier authors, Söderström (1920), Hannerz (1956), and Orrhage (1964). The 29 spionid genera and five non-spionid spioniform genera were treated as ingroup taxa, with outgroup taxa consisting of *Cossura* (Cossuridae) and *Cirrophorus* (Paraonidae). *Apistobranchus* was treated as an ingroup taxon but behaved as an outgroup. Six recently described spionid genera were omitted due to the lack of information on reproduction and development. The results strongly differ from previous phylogenies. Three clades are obvious: the single enigmatic *Pygospiopsis*, the group comprising *Spio*, *Microspio*, *Pygospio* and all polydorid genera, and a large clade consisting of 19–21 genera with smaller crown clades arranged variously. The most interesting result perhaps is the fact that non-spionid spioniform genera (*Heterospio*, *Poecilochaetus*, *Trochochaeta*, *Uncispio*) are closely related to spionids bearing thickened egg envelopes (such as *Laonice*). This suggests that corresponding families and the paraphyletic family Spionidae as a whole need to be reconsidered. Consistent with previous phylogenies, including the first one by Mesnil (1896), *Malacoceros* and *Marenzelleria* appear very close to each other and to *Scolelepis* and *Parascolelepis*.

A few species of Spionidae have been reported from hydrothermal vent communities: *Loanice asaccata* from the Mid-Atlantic Ridge, *Laubieriellus grasslei* from the Galápagos, *Lindaspio dibranchiata* from the Guaymas Basin, *L. southwardorum* from Juan de Fuca Ridge, *Prionospio sandersi* for the northern East Pacific Rise, *P. unilamellata* from the Mid-Atlantic Ridge, and *Xandaros acanthodes* from the Galápagos. They are usually collected from diffuse flow areas, found in mussel and vestimentiferan washings. Several species are reported but yet undescribed on the East Pacific Rise and in Back-Arc Basins (pers. obs. and J. Blake pers. com.).

During the BIOSPEEDO cruise on the southern part of the East Pacific Rise, several individuals of a large spionid worm with conspicuous lateral horns were collected on chimney walls among *Alvinella pompejana* and *A. caudata* on the site Rehu Marka (17°24.96′S, 113°12.125′W). Only three other annelid species are commonly found in the same environment, the scaleworm *Lepidonotopodium fimbriatum*, the hesionid *Hesiolyra bergi*, and the alvinellid *Paralvinella grasslei*.

The morphological study of the new spionids showed that they do not correspond to any known species but do belong to the genus *Malacoceros* Quatrefages, 1843, emend. Pettibone, 1963. Their inclusion in this genus requires the generic description of *Malacoceros* to be emended to include some unusual strong characters found in the new species.

Materials and Methods

Specimens were collected by the manipulator arm of the manned submersible *Nautile*, during the cruise BIOSPEEDO on the South East Pacific Rise.

One specimen, preserved with 7% formalin in sea water and transferred to 80% ethanol, was prepared for scanning electron microscopy (*SEM*). The specimen was critical point-dried with carbon dioxide, sputter coated with gold, and examined with a Philips scanning electron microscope (XL30).

The holotype (USNM 1092991) and one paratype (USNM 1092992) are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A., and one paratype (MNHN POLY 1480) has been deposited in the Museum National d'Histoire Naturelle, Paris, France.

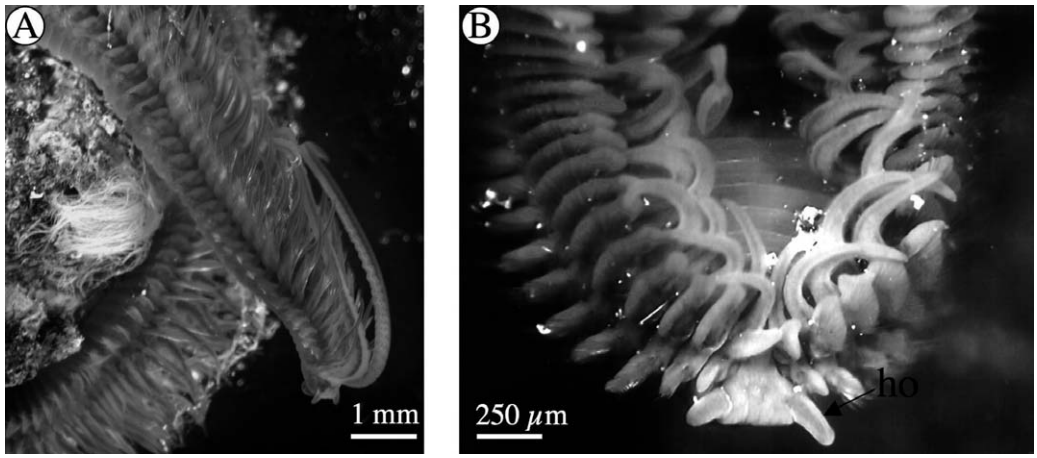

Fig. 1. A, view of live specimen observed with dissecting microscope; B, detail of anterior region of formaldehyde-preserved specimen.

Family Spionidae Grube, 1850
Genus *Malacoceros* Quatrefages, 1843, emended
Type species *Spio vulgaris* Johnston, 1827

The morphological study of the new species of Spionidae described in this paper showed that they are very close to *Malacoceros* Quatrefages, 1843, emend. Pettibone, 1963. The main differences are the occurrence of large scalpel-like aristate anterior neurosetae and the unidentate hodded hooks from posterior neuropodia. These differences do not warrant the erection of a new genus, and this large spionid species should be placed in the genus *Malacoceros*, which requires a new emendation of its diagnosis to include these characters.

Generic diagnosis.—The most recent diagnosis of the genus *Malacoceros* Quatrefages, 1843 is given by Blake (1996:105) as follows: ''Prostomium with frontal horns; eyes present or absent; occipital antenna absent. Branchiae from setiger 1, to near end of body; branchiae basally fused to dorsal lamellae. Notosetae capillaries; neurosetae include capillaries, hooded hooks and sabre setae; hooks bi-, tri- or quadridentate. Pygidium with anal cirri.'' The inclusion of the new hydrothermal vent species in the genus *Malacoceros* necessitates several changes to the second sentence of this diagnosis: ''Branchiae from setiger 1 to near the end or the end of the body; branchiae basally fused to dorsal lamella. Notosetae capillaries; neurosetae include capillaries, anterior scalpel setae often bearing an arista, hooded uni-, bi, tri- or quadridentate hooks and sabre setae.''

Malacoceros samurai, new species
Figs. 1–4

Material examined.—Eleven specimens collected from a chimney surface grab on the site Rehu Marka (17°24.96′S, 113°12.125′W, *Nautile* dive 1584).

Description.—Large species, measuring up to 78 mm in length and 6 mm in width, for 219 segments (holotype). Complete paratypes with 205 segments (55 mm, USNM 1092992) and 255 segments (67 mm, MNHN POLY 1480). No well-defined body regions. Color light to dark brown in formaldehyde. Live animals (Fig. 1A) deep red due to hemoglobin in blood vessels. Prostomium anteriorly bilobed, bearing two conspicuous lateral semi-articulated horns (Figs. 1, 2A), and partly hidden by two large palps (Fig. 1A); posterior keel present, extend-

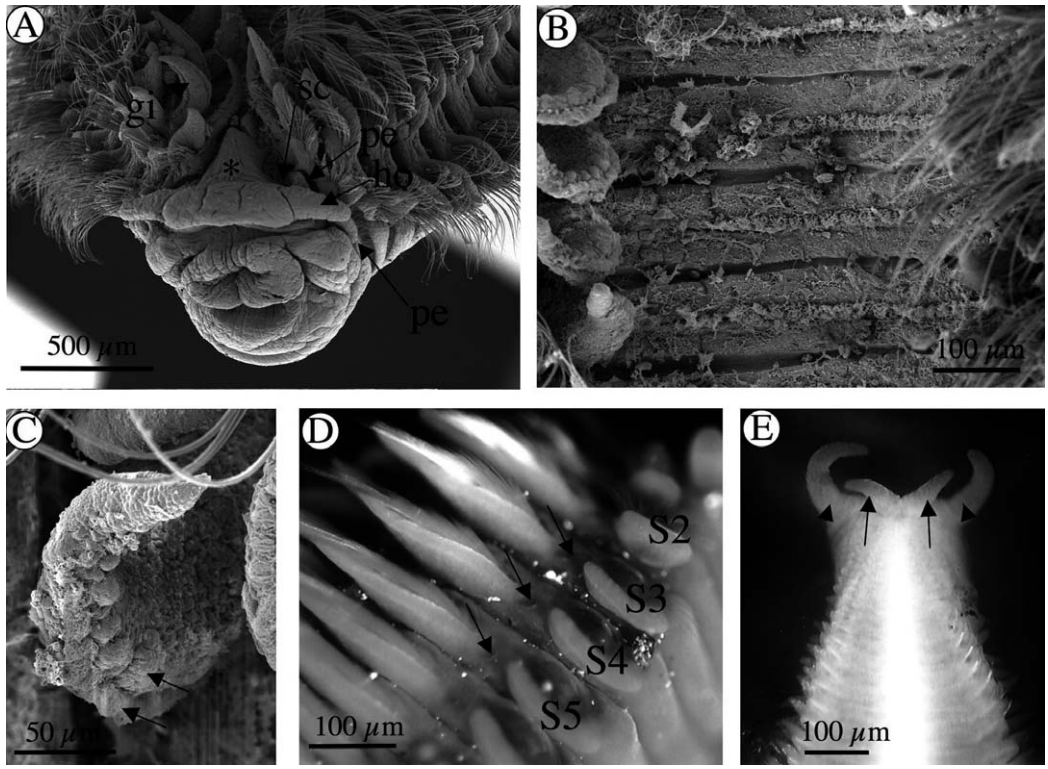

Fig. 2. A–C *SEM* micrographs. D–E Light microscopic views. A, detail of the anterior end. *, keel; gi, gill; ho, horn; pe, peristomium; sc, scar of palp insertion; B, dorsal view of mid-body region showing transverse bands of cilia on each segment; C, detail of gill showing two rows of cilia (arrows); D, lateral view of anterior region (dorsal side to upper left corner) showing dimples between two rami (arrows) on few segments (S1–S5); E, ventral view of cylindrical pygidial area with parapodia becoming ventrally oriented, median pair of anal cirri (arrows) and lateral pair of ventral cirri (arrow heads).

ing to second setiger (Fig. 2A). Two longitudinal grooves in anterior part of prostomium. Palps inserted dorsally at junction of prostomium and peristomium (Fig. 2A) and tapering to pointed tip, extending to segment 12–13 (Fig. 1A). No occipital antenna. Eyes lacking. Peristomium visible dorsally along side of keel and ventrally as pair of rounded paired lateral lips located behind another pair of rounded structures (Fig. 2A). Peristomium does not form wings or hood. Setiger 1 biramous, bearing first pair of branchiae (Fig. 2A). Noto- and neuropodial lamellae of setiger 1 well developed, but smaller than in following setigers (Figs. 1B, 2A). Setigers markedly increase in size from setiger 1 to setiger 7 (Fig. 1B). Neuropodial lamellae nearly pentagonal in outline with ''nipple,'' notopodial lamellae lanceolate (Figs. 2A, D, 3A–D). Outline of lamellae remains unchanged along body but lamellae become smaller from posterior third of body (Fig. 3). Lamellae inserted posterior to fascicles of setae in both noto- and neuropodia. Intersegmental ventral area slightly papillose. Area between both rami with marked interramal dimple which may correspond to nephridial openings or precursors of genital pouches (Fig. 2D, also visible as slits on Fig. 2A). Branchiae present on all setigers, basally fused to notopodial lamellae, decreasing in size on posterior segments, with two rows of cilia (Fig. 2B, C), one projecting anteriorly

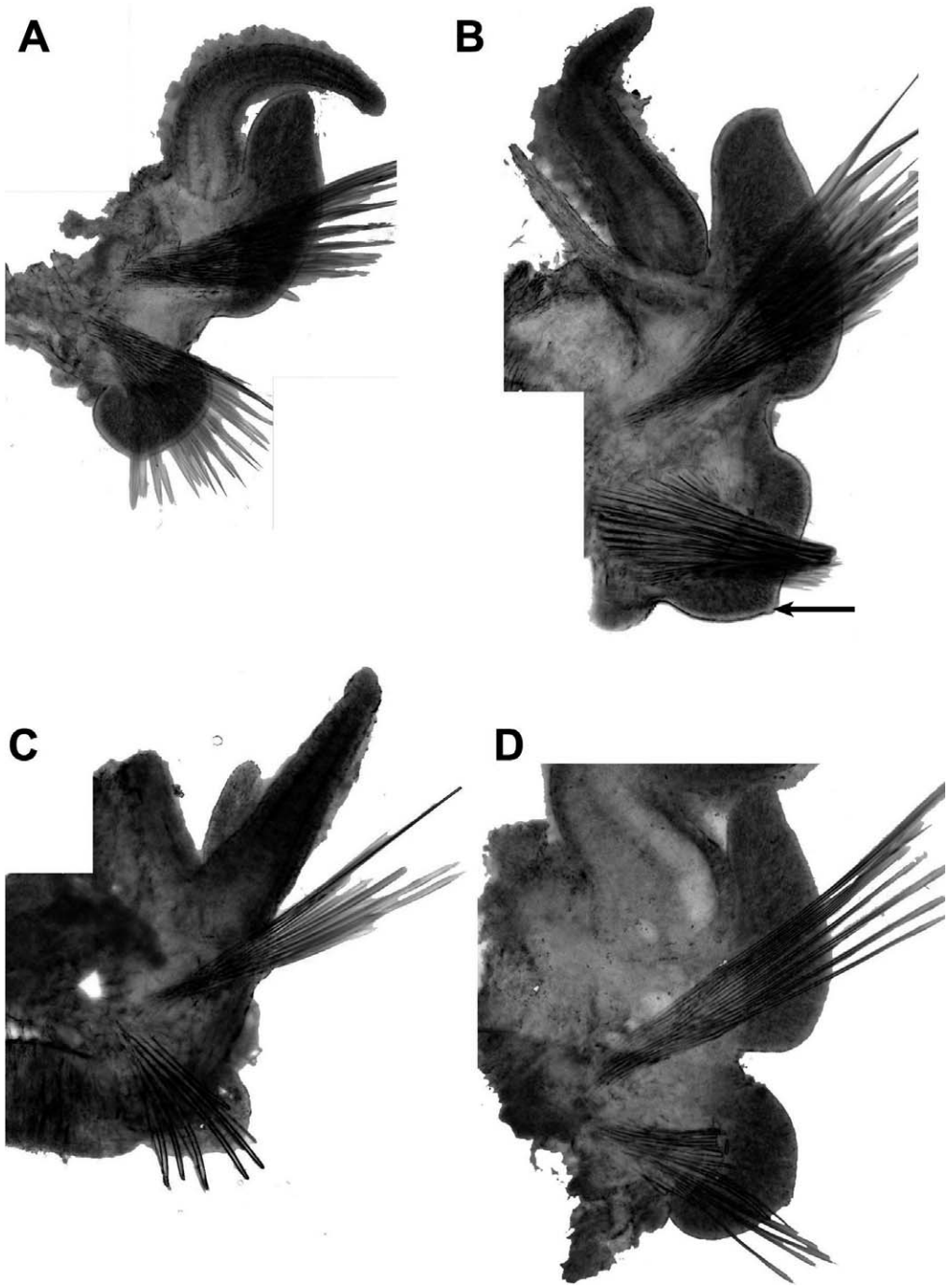

Fig. 3. Light microscopic photographs of lactic-acid mounted parapodia showing "nipple" (arrow) on neuropodial lamella. A, setiger 5; B, setiger 20; C, setiger 40; D, setiger 86.

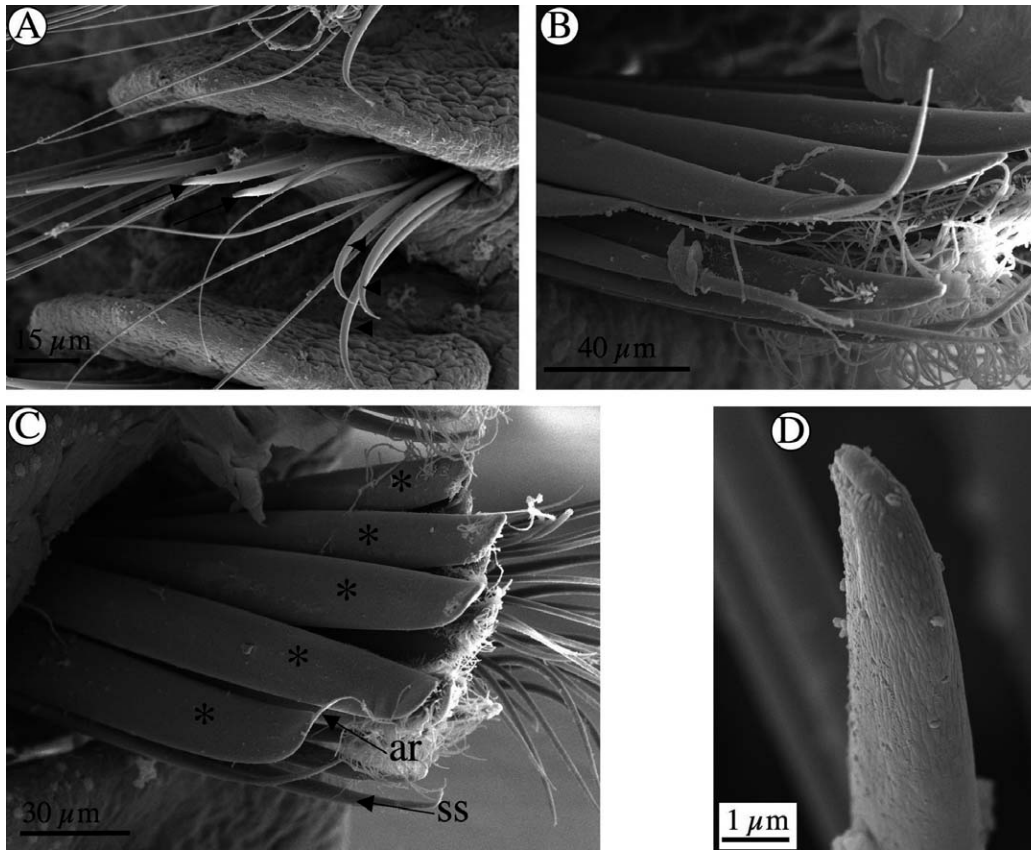

Fig. 4. *SEM* micrographs. A, parapodium of segment 40, showing hooded hooks (arrows), sabre setae (arrow heads) and capillary setae. Dorsal to left; B, detail of sabre setae; C, setae on segment 15 showing scalpel-like aristate setae (*). ar, arista; ss, sabre seta; D, hooded hook.

and the other posteriorly, both on dorsal and ventral edges. All gills generally directed inward, with distal part curving outward for largest ones (Figs. 1B, 2A). Each segment with a median transverse row of cilia (Fig. 2B). Most setae capillaries, narrow, not granulate (Figs. 2B, 4A). Anterior and dorsally to capillaries neuropodia 10–34 bear few non-granulated sabre-like setae and 10–12 large scalpel-like setae (Fig. 4B, C). Scalpel-like setae with straight dorsal edge and curved ventral edge close to tip and often bearing arista (Fig. 4C). Following neuropodia bear hooded hooks with single rounded tip (Fig. 4D) together with capillaries and sabre-like setae. Pygidial area cylindrical, last 10–15 segments only slightly protruding from its surface (Fig. 2E). Parapodia migrating closer to median area on ventral side (Fig. 2E). Two pairs of anal cirri project ventrally; median (more ventral) cirri smaller and straight, more exterior ones longer and slightly curved inward (Fig. 2E).

Remarks.—Although the specimens were collected along with *Alvinella pompejana* and *A. caudata*, they were not observed in situ on the chimney wall before collection. None of the specimens were gravid females. Therefore, the morphology of the eggs cannot be included in the present description. Despite a strong sampling effort of the chimney fauna from 7°25′S to 21°33′S on the southern East Pacific Rise, the species was only

Table 1.—Comparison of certain features of *Malacoceros samurai* with other species of the genus.

Species	Orientation of horns	Scalpel setae (on segments)	Sabre setae (starting setiger)	Hooded hooks (starting setiger)	Teeth on hooks	Anal cirri
M. samurai [a]	Latero-frontal	10–34	35	35	1, rounded	4
M. fuliginosus [b]	Lateral	Absent	?	30–45	2	6–8
M. indicus [c]	Latero-frontal	Absent	Acicular setae	30–50	4	4 [e]
M. vanderhorsti [d]	Frontal	Absent	Acicular setae	70	3–4	2
M. tripartitus [e]	Lateral	Absent	25	31	3	6
M. reductus [c]	Lateral	Absent	20	20	3	6
M. tetracerus [f]	Lateral	Absent	?	20–28	2	6–8
M. vulgaris [g]	Lateral	Absent	?	30–40	3	15–30

[a] Indicative segment numbers given for the holotype.
[b] Fauvel (1927).
[c] Blake & Kudenov (1978).
[d] Foster (1971).
[e] Blake (1996).
[f] as *Scololepis ciliata* in Fauvel (1927).
[g] as *Scololepis girardi* in Fauvel (1927).

collected from a single chimney at the site Rehu Marka (17°25′S).

Etymology.—The species name refers to the scalpel-like neurosetae found on the middle segments that are reminiscent of samurai sabers.

Discussion

Table 1 provides a comparison of characters for the seven other currently recognized species of *Malacoceros*. *Malacoceros samurai* clearly stands apart from the other species of the genus by having a single tooth on the hooded hooks and the unique scalpel setae. *Malacoceros samurai* most closely resembles *M. indicus* by the orientation of the frontal horns and the number of anal cirri (four). Other species of *Malacoceros* usually possess from 2 to 6–8 anal cirri, and up to 15–30 for *M. vulgaris*, type species for the genus.

Even though *Malacoceros samurai* was only collected at one site, the challenging conditions encountered on the chimney walls strongly suggest that the species must possess specific adaptations and that it is most likely endemic to this environment, as are *Alvinella pompejana*, *A. caudata*, *Hesiolyra bergi*, and *Lepidonotopodium fimbriatum*.

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