

A new species of *Chaetopterus* (Annelida, Chaetopteridae) from Hong Kong

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Abstract

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A new species, *Chaetopterus qiani* sp. nov., is described based on 18 specimens collected from a fish farm in Hong Kong. This species is small (body length: 11.5–35.5 mm), with nine, five and 10–16 chaetigers in regions A, B and C, respectively. It belongs to a small group of epibenthic *Chaetopterus* species with long notopodia in region C. This species can be distinguished from other epibenthic *Chaetopterus* by a combination of the following features: up to 16 light-brownish cutting chaetae in A4, wide neuropodia in A9, large wing-shaped notopodia in B1, 10–16 chaetigers in region C, long club-shaped notopodia and a short conical dorsal cirrus in the dorsal lingule of neuropodia in region C. A key to *Chaetopterus* from the Pacific region is provided.

Keywords

taxonomy, polychaete, *Chaetopterus*, new species, Hong Kong

Introduction

Chaetopterus is a genus of tubicolous polychaetes characterised by having three distinct body regions. Their body is highly modified for a unique way of filter-feeding: the first pair of the middle parapodia are extremely long and aliform (wing-shaped) and secrete a mucus bag to trap food particles from the water current; the last three pairs of the middle parapodia are fused to form semicircular fans, whose beating, like moving pistons, creates a current of water through the tube (Brown, 1975). *Chaetopterus* species are frequently used as model organisms in studies of reproduction and early development (Irvine et al., 1999; Petersen et al., 2000; Yang et al., 2004), as well as of bioluminescence (Shimomura, 2006).

Despite the common use of *Chaetopterus* as an experimental model, there has been confusion over the number of valid species in the genus. Fauvel (1927, 1953) synonymised several species of *Chaetopterus* with *C. variopedatus* (Renier, 1804), as he considered the variations in body size, number of anterior segments, and length of parapodia to be intraspecific, representing ontogenetic changes or incomplete regeneration following autotomy. Hartman (1959) went further and synonymised all 25 nominal *Chaetopterus* species with *C. variopedatus*, suggesting that there are no reliable morphological distinctions among them. This cosmopolitan species concept

was supported by the observation of Scheltema (1971) on planktonic samples, which indicated that *Chaetopterus* larvae would be able to widely disperse through the transoceanic current. However, the cosmopolitan species concept was challenged by Petersen (1984a, 1984b, 1997), who stated that '*C. variopedatus*' represents a species complex containing at least ten species. The concept that *C. variopedatus* is a single cosmopolitan species was also refuted by a phylogenetic analysis based on molecular data (Osborn et al., 2007). Indeed, recent studies of *Chaetopterus* have recognised many more species, and their distribution ranges may well be more limited. From Japan, three new species (*C. izuensis*, *C. japonicus* and *C. pacificus*) have been discovered, and three species (*C. cautus*, *C. takahashii* and *C. longipes*) have been redescribed (Nishi, 2001). From the Galapagos Islands, three new species (*C. aduncus*, *C. charlesdarwinii* and *C. galapagensis*) have been published, and two species (*C. longipes* and *C. macropus*) have been redescribed (Nishi et al., 2009). In addition to the aforementioned benthic or epibenthic species, *Chaetopterus* also has one pelagic species (*C. pugaporcinus*) (Osborn et al., 2007), collected at depths of between 875 and 3000 m in Monterey Bay, California, although it was not certain whether these specimens were larvae or adults. Several morphological traits (e.g. tube shape, infaunal or epifaunal habitat, shape and colour of A4 modified chaetae, and shape of cirri in the lateral lobe of region C notopodia) have

Table 1. Major quantitative morphological parameters in *Chaetopterus qiani* sp. nov.

Catalogue number	Body length (mm)	Length of region (mm)			Body width (mm)	No. of chaetigers in C	Length of notopodia in B1 (mm)	No. of modified chaetae in A4	Length of tentacle (mm)	Sex	Remarks
		A	B	C							
Holotype											
MBM179979	24.3	5.4	11.7	7.2	4	12	4.7	10	3.6	♀	
Paratype											
MBM179980	28.3	6.2	10	12.1	4.3	12	5.1	16	2.4	?	
MBM179981	28.6	6.6	10.4	11.6	4.2	15	4.5	16	2.6	?	
MBM179982	21.1	4.5	8.5	8.1	3.5	11	2.7	10	1.5	?	
MBM179983	24.4	<i>n.r.</i>	13.1	11.3	2.7	15	3.5	<i>n.r.</i>	<i>n.r.</i>	♀	a
MBM179984	23.7	4.5	11.4	7.8	3.6	10	3.8	11	2.5	?	
MBM179985	26.1	6.8	10	9.3	3.6	13	4.6	10	2.3	?	
MBM179986	31.2	6.5	14.3	10.4	3.6	11	5.2	12	2.5	?	
AM W46121	26.1	3.4	13.8	8.9	5.9	11	4.3	13	2.5	?	
AM W46122	17.8	3.6	8.6	5.6	3.5	12	3.4	9	1.9	♀	
AM W46123	33.4	7.1	22	4.3	4.5	10	5.7	14	3	♀	
AM W46124	17.5	4.2	7.5	5.8	3.5	10	4.1	10	2	?	
AM W46125	35.6	6.5	23	6.1	4	6	5.6	13	3.3	?	b
AM W46126	27.6	5	13.2	9.4	3.5	16	4.1	15	<i>n.r.</i>	?	
AM W46127	11.6	3	5.4	3.2	2.4	10	2	8	2.5	?	
AM W46128	26	4.6	14.6	6.8	4.5	12	4.6	11	2.2	♀	
AM W46129	5.5	6.5	<i>n.r.</i>	<i>n.r.</i>	4.0	<i>n.r.</i>	4	13	4	?	c

n.r. = character not recorded due to loss of the anterior or posterior part. ? = individuals whose sex cannot be determined by light microscopy. ^aIncomplete specimen without region A. ^bIn this specimen, region C has 6 chaetigers only; the posterior part of region C is missing. ^cIncomplete specimen without region C.

been found to be useful for distinguishing *Chaetopterus* species (Petersen, 1984a, 1984b, 1997; Nishi et al., 2000, 2009; Nishi, 2001; Osborn et al., 2007).

Along the Chinese coasts, the only recorded species is *C. variopedatus*, which is likely to be *C. cautus*, according to the description by Yang and Sun (1988). Here we describe *Chaetopterus qiani* sp. nov. from Hong Kong and provide a key to the *Chaetopterus* species in the Pacific region.

Materials and methods

Samples were hand-collected from a floating raft in a fish farm at Port Shelter, Hong Kong. They were fixed in 10% formaldehyde and then transferred to 75% ethanol one week later. The morphology of specimens was observed under a stereomicroscope and a compound microscope. Scaled photographs of the whole body and body structures were taken using a Digital Sight DS-SM camera mounted on an Olympus SZX 16 microscope. One paratype was dehydrated with

graded concentrations of ethanol, critical point dried using a BAL-TEC CPD 030 Critical Point Dryer, and observed under a LEO 1530 FESEM scanning electron microscope.

Types are deposited in The Marine Biological Science Museum (MBM) of the Chinese Academy of Sciences, Qingdao, China, and in the Australian Museum (AM), Sydney, Australia (table 1). Description was mainly based on the holotype, with supplementary data from the paratypes showing the variations in morphological characters; SEM micrographs were generated to show the details of the chaetae.

Systematics

Genus *Chaetopterus* Cuvier, 1830

Chaetopterus qiani sp. nov.

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Figures 1A–G, 2A–H

Material examined. 18 specimens. All type specimens were collected from the fish farm in Port Shelter, Hong Kong (22°20'37.15"N 114°16'58.70"E) on 19 Mar 1998. Holotype: MBM179979, 1 complete specimen in tube with eggs in the parapodia of region C. Paratypes: MBM79980–79986, AM W46121–W46129 and AM W46131 (table 1).

Diagnosis. 9 chaetigers in region A; modified chaetae of A4 light brown, 10–12 in number; wide neuropodia in A9; large wing-shaped notopodia in B1; long club-shaped notopodia and short conical dorsal cirrus in the dorsal lobe of neuropodia in region C; uncini with 7–9 teeth on lateral lobe of C1, and 10–13 teeth on ventral lobe of C1.

Description. Holotype complete with tube (fig. 1A–C), total length 24.3 mm: 5.4 mm in region A, 11.7 mm in region B, and 7.2 mm in region C. Widest part of region A 4 mm.

Region A with 9 chaetigers. Prostomium small, with anterior border rounded, entire. Peristomium extended, completely covering prostomium; wide-horseshoe shaped in anterior view. Two grooved palps extending beyond peristomium, length 3.6 mm (fig. 1A). A pair of eyes present, located at the base of palps. Middorsal ciliated groove extending through region A (fig. 1A). Ventral surface with a long, slender ventral shield (plastron) (fig. 1B): length 4.2 mm, width 2 mm. First 8 chaetigers uniramous, with long, triangular notopodia. Notopodia of A6 longest (figs 1D, 2A). Ninth chaetiger biramous, with long notopodium and stubby neuropodial lobe. Each notopodium with 2–3 rows of light-yellow lanceolate chaetae; dorsal chaetae longer and more slender than lateral ones (fig. 2B, D–E). Notopodia of A4 with 10 modified chaetae. Modified chaetae light brown and club-shaped, with knob-like expanded tip, and arranged in 3 or 4 rows with 2–4 chaetae per row (figs 1E, 2B–C). Neuropodia of A9 with a row of uncini; uncini bluntly D-shaped, with 6–7 teeth in a single row (fig. 2F).

Region B with 5 chaetigers. Digestive gland green in fresh material; colour lost in ethanol-preserved specimens. Parapodia biramous. B1 with enormously enlarged, distally tapering, aliform notopodia extending to A1 (fig. 1A). B2 with elongate parapodium modified as large cupule. B3–B5 fused middorsally, forming enlarged fans. All notopodia of region B without chaetae or uncini. Neuropodia of B1 and B2 with upper and lower uncini lobe, B3–B5 with lower uncini lobe only. Uncini in a single row, similar in shape with uncini in region A; with 5–6 teeth in upper and lower lobe of B1 and B2 (fig. 2G), and 9–10 teeth in B3–B5.

Region C with 14 chaetigers. Parapodia all biramous. Notopodia long, club-shaped with slightly swollen tip (fig. 1A, B). Neuropodia bilobed; lateral lobe with papillary cirrus on lateral side only; ventral neuropodial lobe without cirrus (fig. 1F). Eggs present in neuropodia of holotype (fig. 1G). Uncini of region C similar to those of region A in shape, with 6–7 teeth in lateral neuropodial lobe of C1, and 10–13 teeth in ventral neuropodial lobe of C1 (fig. 2H). Other uncini of region C with 7–9 teeth.

Variation. Several morphological parameters show variations among the type specimens (table 1). The body length varies from 11.6–35.6 mm and the width from 2.4–4.5 mm. The number of modified chaetae in A4 ranges from 8–16. The first

notopodia in region B extends to chaetiger A1 in 7 specimens, to A2 in 3 specimens and to A4 in 5 specimens. The number of chaetigers in region C varies from 10–16. Of the type specimens, 5 are females with observable eggs under the body wall, but sex is indeterminable in other type specimens.

Type location and distribution. Currently only known from Port Shelter, Hong Kong.

Etymology. This species is named in honour of Professor Pei-Yuan Qian to recognise his support for polychaete research.

Discussion

Petersen (1984a, 1984b, 1997) separated *Chaetopterus* into two groups according to habitat and tube characteristics: large benthic species with a U-shaped tube, and small epibenthic species with an irregularly shaped tube. According to this classification, *C. qiani* sp. nov. belongs to the epibenthic group, which also includes six other species of *Chaetopterus* from the Pacific region: *C. aduncus* Nishi, Hickman and Bailey-Brock, 2009; *C. charlesdarwinii* Nishi, Hickman and Bailey-Brock, 2009; *C. gregarius* Nishi, Arai and Sasanuma, 2001; *C. izuensis* Nishi, 2001; *C. japonicus* Nishi, 2001; and *C. longipes* Crossland, 1904. This group is characterised by small size (<30 mm in body length) and only a small number of chaetigers in region C (<20). Nishi et al. (2000) proposed 30 characters for distinguishing *Chaetopterus* species. Among them, ten characteristics were used for distinguishing the Pacific species: presence/absence of eyes, morphology of prostomium and peristomium, number of chaetigers in region A, colour and shape of modified chaetae in A4, presence/absence of neuropodia on the last chaetiger in region A, relative size of notopodia in region A, shape and size of notopodia in B1, size and number of teeth in uncini in regions B and C, presence/absence of rudimentary cirri on the lateral lobe of neuropodia in region C, and tube shape and composition.

Based on these morphological characters, *C. qiani* sp. nov. can be distinguished from other species in the epibenthic group of the Pacific region by a combination of characters. It has nine chaetigers in region A, whereas *C. aduncus* has 10–11 chaetigers in region A. The new species has neuropodia in A9, whereas *C. longipes* does not have neuropodia in any of the region A segments. It has eyes and the tubes are muddy, whereas *C. izuensis* does not have eyes and its tubes are sandy. *Chaetopterus qiani* sp. nov. can be distinguished from *C. charlesdarwinii* and *C. gregarius* by the colour and arrangement of the modified chaetae in A4. The A4 modified chaetae of *C. qiani* sp. nov. are light brown and arranged in three or four rows with two to four chaetae per row, whereas the modified chaetae of *C. charlesdarwinii* and *C. gregarius* are dark brown and arranged in one row only. *Chaetopterus qiani* sp. nov. is similar to *C. japonicus* (recorded from the southern Pacific side of central Japan) in the presence of eyes and light-brown modified chaetae in A4. However, the tube of *C. qiani* sp. nov. is irregularly curved or J-shaped and muddy, whereas the tube of *C. japonicus* is U-shaped and has sand and shell fragments on the surface. Besides, *C. qiani* sp. nov. has more chaetigers in region C than *C. japonicus* (12 vs. 6).

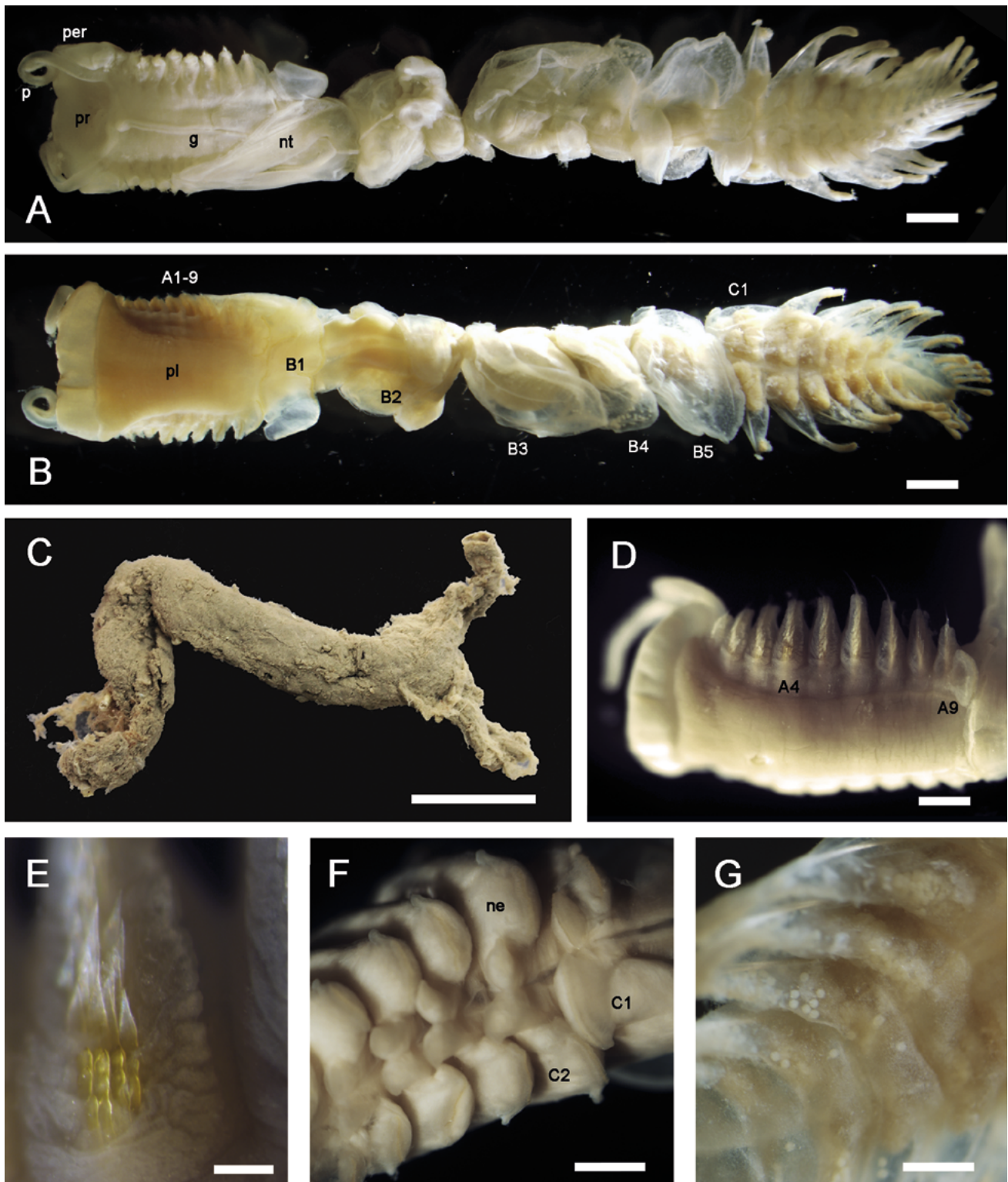


Figure 1. *Chaetopterus qiani* sp. nov., A–C, G: holotype MBM179979. D–F: paratype BU01. A, dorsal view of the whole worm; B, ventral view of the whole worm; C, tube; D, region A, lateral view; E, notopodium of A4 showing modified chaetae; F, ventral view of neuropodia in region C; G, notopodia of region C, showing eggs. A, B and C# = region A, B and C chaetigers, g = mid-dorsal ciliated groove, nt = notopodia, ne = neuropodia, p = palp, per = peristomium, pl = ventral shield (plastron), pr = prostomium. Bar scales: A–B, D, F–G: 1 mm, C: 1 cm, E: 200 μ m.

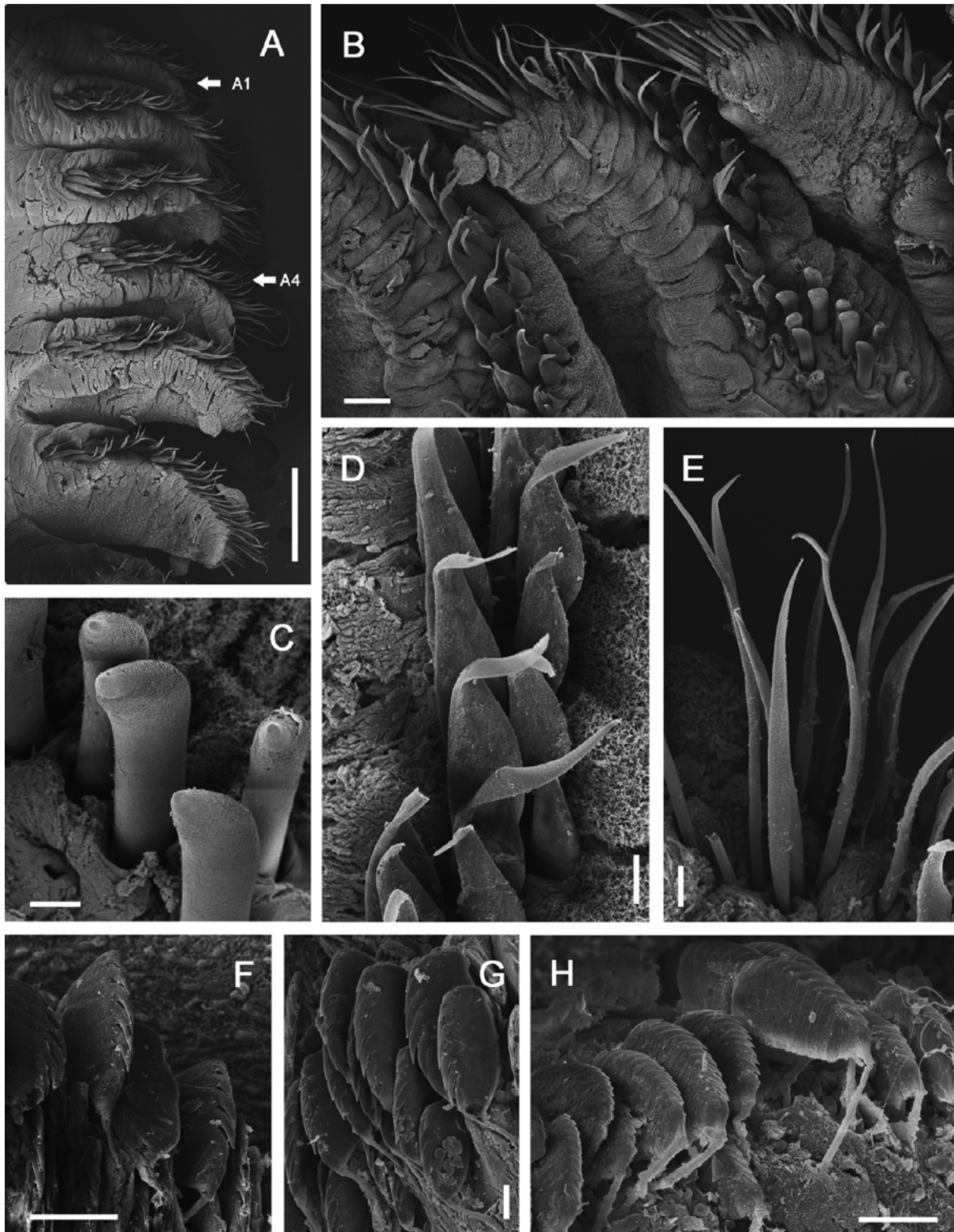


Figure 2. *Chaetopterus qiani* sp. nov., paratype AM W46131. A, A1–6 showing the relative size and arrangement of chaetae, with arrows indicating the positions of chaetigers A1 and A4; B, A3–4, showing the different shapes of the lateral chaetae; C, modified chaetae of A4; D, lanceolate chaetae on lateral side of notopodium; E, lanceolate chaetae on dorsal side of notopodium; F, uncini in neuropodium of A9; G, uncini in neuropodia of B1; H, uncini in neuropodia of C1. Bar scales: A: 500 μ m, B: 100 μ m, C–E: 20 μ m, F–H: 10 μ m.

Among the characters that have been used to compare species recorded from the Pacific region (Nishi et al., 2009), some (body width, ratio of length/width of ventral shield, and number of teeth of uncini in each region) exhibit overlap in ranges, but others (shape and composition of tubes, the presence/absence of eye spots, number of chaetigers in region A and region C, number and shape of pairs of A4 modified chaetae, and shape of neuropodial cirri) can be applied to distinguish *Chaetopterus* species. Based on these morphological characters, a key to the *Chaetopterus* spp. is provided.

Key to Pacific species of *Chaetopterus*

- 1 Benthic, with most of the tube buried in bottom 7
 - Epibenthic, with the tube attached to a solid surface 2
- 2 Region A with 10–11 chaetigers *C. aduncus*
 - Region A with 9 chaetigers 3
- 3 Last chaetiger of region A unilobed *C. longipes*
 - Last chaetiger of region A bilobed 4
- 4 Tube fragile, made of sand and shell debris; notopodia of B1 straight and slender *C. izuensis*
 - Tube parchment-like, made of mud; notopodia of B1 triangular 5
- 5 A4 modified chaetae light brown; notopodia of region C club-shaped with slightly swollen end *C. qiani* sp. nov.
 - A4 modified chaetae dark brown; notopodia of region C lanceolate with tapered end 6
- 6 Region A with a prominent bulbous swelling on the dorsal side of notopodia; uncini with 8–9 teeth in B1, 9–10 teeth in B3 *C. charlesdarwinii*
 - Region A without swelling; uncini with 6–7 teeth in B1, 5–6 teeth in B3 *C. gregarius*
- 7 Neuropodial dorsal cirri of region C long 8
 - Neuropodial dorsal cirri of region C short or rudimentary 9
- 8 Neuropodial ventral lobe in region C with both dorsal and ventral cirri *C. cautus*
 - Neuropodial ventral lobe in region C with dorsal cirrus only *C. pacificus*
- 9 Region A with 13–15 chaetigers *C. galapagensis*
 - Region A with less than 12 chaetigers 10
- 10 Region C with 5–8 chaetigers *C. japonicus*
 - Region C with more than 10 chaetigers 11
- 11 Region A with a prominent bulbous swelling on the dorsal side of notopodia *C. macropus*
 - Dorsal swelling in region A absent *C. variopedatus*

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