



Clavadoce (Annelida: Phyllodocidae) from Australia

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Abstract

The first records of the phyllodocid genus *Clavadoce* are provided from Australia, where the fifth species in the genus is now known: *Clavadoce dorsolobata* (Hartmann-Schröder, 1987) comb. nov. which is widely distributed in intertidal habitats in southeastern Australia. *Clavadoce dorsolobata* was described as *Eumida* (*Sige*) *dorsolobata* Hartmann-Schröder, 1987 and herein transferred to *Clavadoce*. Five species of *Clavadoce* are now known world wide, four of which are from different regions on the Pacific Ocean margin, while *Clavadoce cristata* is from the North Atlantic. The Australian species is the first record of *Clavadoce* for the southern hemisphere.

Key words: Phyllodocidae, *Nereiphylla*, *Notophyllum*, benthic, algal turfs

Introduction

The genus *Clavadoce* Hartman, 1936 comprises species of Phyllodocidae with fusiform or “teardrop”-shaped antennae, palps and tentacular cirri, widest at about half length and usually with distinctly narrowed tip section. Species of *Nereiphylla* are similar but lack the fifth (median) antenna. Members of both genera also share the oblique orientation (relative to the aciculum) of the ventral cirrus and typical yellow-brown pigmentation.

The currently accepted concept of *Clavadoce* is due to Banse (1973) who modified the definition of Hartman (1936) to include in *Clavadoce* only species with: uniramous parapodia, four pairs of club-shaped or flattened tentacular cirri; five antennae; tentacular segments free (but first dorsally reduced); proboscis with diffusely arranged papillae; ventral cirrus very large, markedly oblique or at right angles to acicula. That concept, and especially the obliquely-oriented ventral cirrus, was validated in the cladistic treatment of Pleijel (1991) whose generic description is adopted below.

The phyllodocid genera most likely to be confused with *Clavadoce* are *Nereiphylla* Blainville, 1828 and *Notophyllum* Örsted, 1843. Each is discussed in turn below.

The presence of a fifth median antenna separates *Clavadoce* from *Nereiphylla* but since Pleijel's (1991) analysis showed the presence of a median antenna to be plesiomorphic, it is possible that *Clavadoce* is paraphyletic with respect to *Nereiphylla*. Nevertheless Pleijel (1991) and subsequent authors retained *Clavadoce*, which now includes 5 species (Table 1).

Clavadoce shares with *Notophyllum* Örsted, 1843 the presence of obliquely oriented ventral cirri and 3 fusiform antennae. *Notophyllum*, however, is distinguished by the presence of notoacaculae (which are difficult to observe), prominent nuchal lobes, lateral rows of enlarged papillae on the pharynx and very large dorsal cirri covering much of the dorsum (Kato and Pleijel 2002).

Methods

Sources of material. The first collections of *Clavadoce* specimens from Australia are misidentifications: they were originally reported as *Eumida* (*Sige*) *dorsolobata* Hartmann-Schröder, 1987 (Hartmann-Schröder 1987; 1989;

1990). Hartmann-Schröder's material is deposited in the Zoological Museum, University of Hamburg, Hamburg, Germany, where one of us (EG) examined the holotype and paratypes (see Material Examined section below). The bulk of the material reported here was collected by members of the Marine Research Group (MRG) of the Field Naturalists Club of Victoria and deposited in Museum Victoria; photographs of living specimens were made by Leon Altoff of the MRG using a Pentax DSLR with Olympus bellows and macro lenses. Australian locations from which *Clavadoce* specimens are now known are shown in Figure 1A.

Material examined lists use the following abbreviations. HZM—Zoological Museum, University of Hamburg, Hamburg, Germany; MV—Museum Victoria, Melbourne, Australia. All specimens are entire.

Description of characters and procedures. *Clavadoce* are small fragile worms, with antennae, palps, tentacular cirri and dorsal cirri easily dislodged. Dissection of parapodia is impossible without causing damage to specimens (for example, in the paratype of *Clavadoce dorsolobata* HZM P18839 all antennae, palps and tentacular cirri were found to be missing when we re-examined the material). Most of our specimens are covered with mucus which we were unable to remove without causing damage to appendages. Morphology is best observed by photography of live specimens (here using Pentax digital SLR and Olympus macro lens and bellows; Figures 2A–C) and of fixed specimens (using a Nikon digital SLR and macro lens and Zerene® photomontaging software, Figure 2D). Specimens were critical-point dried before mounting on carbon tabs, sputter-coated with gold, and examined in a Philips XL30 FEG SEM.

Width is measured at chaetiger 10, excluding parapodia.

Taxonomic account

Family Phyllodocidae Williams, 1852

Genus *Clavadoce* Hartman, 1936

Clavadoce Hartman, 1936: 123

Cirrodoce Hartman & Fauchald, 1971: 39–40 *vide* Blake, 1988.

Type species: *Clavadoce splendida* Hartman, 1936 (by original designation)

Diagnosis. Phyllodocidae with two frontal and one median antennae and one ventral pair of palps, segment 1 dorsally reduced, 4 pairs of tentacular cirri (1+2+1), neurochaetae present from segment 2, proboscis with diffusely distributed papillae, parapodia uniramous, longitudinal axis of ventral cirrus oriented obliquely to aciculum.

Remarks. The diagnosis above follows Pleijel (1991) with the following additions. One pair of large eyes (as also noted by Blake 1997). Anal cirri may be tapering (in *Clavadoce cristata*) or digitiform (in *C. dorsolobata*); unknown in other described species.

The four frontal appendages of phyllodocids, although typically similar in form, comprise a dorsal pair of antennae and a ventral pair of palps and are homologous with the structures of the same name in Nereididae and other Phyllodociformia. However, much of the earlier literature on Phyllodocidae refers collectively to these appendages as antennae.

Clavadoce dorsolobata (Hartmann-Schröder, 1987) **comb. nov.**

Figures 1A–D, 2 A–D

Eumida (*Sige*) *dorsolobata* Hartmann-Schröder, 1987: 31, figs 2–6.—1989: 15.—1990: 43.

Material examined. Type material: Australia: Victoria: Warrnambool, Breakwater Rock erosion terrace, at Aquarium, 22 Dec 1975, 38° 24.23'S 142° 28.53'E, 0–1m, G. Hartmann-Schröder, ZMH P18837, holotype.

Victoria: as for holotype, ZMH P18838, 1 paratype; Victoria: Point Lonsdale rock platform at lighthouse, 38° 17.48'S, 144° 36.92'E, 0–1 m, 24 Dec 1975, G. Hartmann-Schröder, ZMH P18839, 1 paratype.

TABLE 1. Summary of *Clavadoce* species.

Species	Original combination	Prostomium form	Median antenna insertion	Dorsal cirri form	Distribution; depth range; comments
<i>C. annenkovae</i>	<i>Eulalia (Clavadoce) annenkovae</i> Uschakov, (1950)	rounded oblong, widest posterior to midpoint	at posterior margin of eyes	asymmetrical ventral margin expanded, evenly convex; widest at basal third; length 1.5x width; distinct but rounded tip	Sea of Okhotsk, northwest Pacific Ocean; 34–127 m; synonymised with <i>Cnigrimaculata</i> by Uschakov (1955) but treated as distinct by Read & Fauchald (2015) and here.
<i>C. cristata</i>	<i>Cirrodoce cristata</i> Hartman & Fauchald, 1971	rounded, anterior margin indented	level with eyes	symmetrical, ovoid, evenly convex; widest near base; length 2x width	Georges Bank, western North Atlantic Ocean; 102–196 m; transferred to <i>Clavadoce</i> by Blake (1988).
<i>C. dorsolobata</i>	<i>Eulalia (Sige) dorsolobata</i> Hartmann-Schröder, 1987	rounded oblong, widest anterior to midpoint	at anterior margin of eyes	symmetrical circular (thus widest at midpoint; length = width; no tip)	Southeastern Australia, southwest Pacific Ocean; intertidal; transferred to <i>Clavadoce</i> in this paper.
<i>C. nigrimaculata</i>	<i>Eulalia nigrimaculata</i> Moore, 1909	rounded, widest at midpoint	at posterior margin of eyes	asymmetrical ventral margin expanded, with straight portion; widest at basal third; length 1.5x width; acute tip	Western Canada to California, northeast Pacific Ocean; subtidal to 130 m; synonymised with <i>C. splendida</i> by Pleijel (1991) but treated as distinct by Blake (1997).
<i>C. splendida</i>	<i>Clavadoce splendida</i> Hartman, 1936	rounded oblong, widest posterior to midpoint	anterior to anterior margin of eyes	symmetrical dorsal and ventral margins with straight portion; widest at basal quarter; length 1.8x width; rounded tip	Central California, northeast Pacific Ocean; intertidal to 63 m.

Non-types: Australia: Victoria: Portland, Yellow Rock, Stn MRG 750, 38° 23.33'S, 141° 35.1'E, 2 Feb 2012, 0–1 m, Marine Research Group of FNCV, MV F166892, 1; Portland Bay, Dutton Way, Stn MRG 755, 38° 15'S, 141° 35'E, 2 Feb 2012, 0–1 m, Marine Research Group of FNCV, MV F166893, 1; Dutton Way, Portland north, Stn MRG 773, 38° 19'S, 141° 35'E, Mar 2013, 0–1 m, MV F166895, 1; Port Campbell, west side of Harbour, Stn VNPMS 59, 38° 37.5'S, 142° 59.5'E, 3 Mar 1996, 3.5 m, T.D. O'Hara, MV F90789, 1; Cheviot Beach, Point Nepean, Stn WV 5, 38° 18'S, 144° 40'E, 3 Mar 1998, 3.5–5 m, T.D. O'Hara, MV F90787, 2; Cheviot Beach, Point Nepean, Stn WV 5, 38° 18'S, 144° 40'E, 3 Mar 1998, 3.5–5 m, T.D. O'Hara, MV F166898, 2; Sorrento Back Beach, 38°20'S, 144° 45'E, 0–1 m, T. Costa, 2010, MV F109566, 1; Harmers Haven, south of Wonthaggi, 38° 39'S, 145° 35'E, 11 Mar 2015, 0–1 m, T.J. Hales, MV F166888, 1; Harmers Haven, south of Wonthaggi, 38° 39'S, 145° 35'E, 3 Jan 2012, 0–1 m, T.J. Hales, MV F166890, 1; Shack Bay, Cape Paterson, 38° 41'S, 145° 37'E, Apr 2012, 0–1 m, T.J. Hales, MV F183076, 1; Honeysuckle Point, Shoreham, Stn MRG 763, 38° 26'S, 145° 4'E, 4 Apr 2012, 0–1 m, Marine Research Group of FNCV, MV F166891, 1; McHaffies Point, Phillip Island., Stn MRG 779, 38° 28'S, 145° 14'E, 3 Apr 2013, 0–1 m, MV F166896, 1; Shoreham Beach, Stn MRG 783, 38° 26'S, 145° 3'E, 24 Aug 2013, 0–1m, Falconer Audrey, MV F166897, 1; Shoreham Beach, Stn MRG 786, 38° 26'S, 145° 3'E, 21 Sep 2013, 0–1 m, Falconer Audrey, MV F166894, 1; Gabo Island, Stn MRG 732, 37° 30'S, 149° 50'E, 1 Jan 2011, 0–1 m, Marine Research Group of FNCVMV F166889, 1.

Other material, not examined. From Hartmann-Schröder (1989; 1990): New South Wales: Lake Macquarie, south headland at entrance, 33° 5.25'S, 151° 39.88'E, 0–1 m, ZMH, G. Hartmann-Schröder, 15 Jan 1976, 1; New South Wales: Maclean, Yamba, 29° 26'S, 153° 22'E, 0–1 m, G. Hartmann-Schröder, 18 Jan 1976, ZMH, 1 specimen.

Description. Holotype (ZMH P18837) 22 segments (complete but possibly regenerating posteriorly), 2.6 mm long. The new material reported here, all MV specimens, are larger, 27 chaetigers, 6.4 mm long, 0.7 mm maximum width to 50 chaetigers, 9.8 mm long, 0.45 mm maximum width. Two specimens (MV F109566, F166898) have pharynx fully everted: in both specimens basal two-thirds of pharynx is covered with evenly dispersed small rounded papillae, with about distal one-third of pharynx bare (Figure 2D). No terminal papillae visible. Prostomium (Figure 2B) 1.2 x wider than long, roughly rectangular but with rounded corners and narrowing slightly at posterior margin. One pair of oval red eyes, long axis oriented longitudinally, located slightly posterior to the middle of prostomium and are about half as long as prostomium. Frontal antennae and palps (Figure 1B) are located slightly back from the anterior margin of the prostomium, frontal and median antennae with distinctly narrowed tip section delineated by a constriction, bulbous with widest point at about first quarter of length, tapering basally and distally. Palps similar to frontal antennae but lack narrowed tip section. Median antennae (Figure 1B) similar in form and length to frontal antennae, inserted at midpoint of prostomium approximately level with anterior margin of eyes. Segment 1 reduced and not visible dorsally so that first pair of tentacular cirri appear to insert at posterior margin of prostomium, in total 4 pairs of tentacular cirri (1+2+1). Tentacular cirri (TC) similar in shape to antennae but slightly less bulbous at widest point and without sharply narrowed tip section (Figure 2B). Tentacular cirri of segment 1 and ventral TC on segment 2 twice as long as width of prostomium, dorsal TC of segments 2 and 3 longer, about 3 times width of prostomium. Dorsal cirri oval, symmetrical, about 1.6 x as long as maximum width. Neuropodium a simple symmetrical lobe, ventral cirri slightly asymmetrical, about as long as wide and with small but distinct point at distal end, long axis oriented obliquely dorsal relative to aciculum (Figure 2C). Body wall dorsally with distinct raised skin fold causing pair of raised areas dorsally near base of dorsal cirri, visible on most chaetigers on most specimens from about chaetiger 6–8 (Figure 2B, arrow). Anus a simple circle, oriented dorsally, with slightly raised and orange-pigmented margin. One pair of anal cirri, inserted ventral to anus, spherical in smallest specimens or oval in larger specimens, 1.6 x as long as maximum width (Figure 2C). Chaetae present from segment 2, compound and with shaft strongly serrated at articulation, blade short, evenly tapering and finely serrated at margin (Figure 2D).

Colour: Live specimens with one broad pale yellow dorsal band on each segment, prostomium and distal half of antennae, palps and tentacular cirri with brown pigmentation, dorsal cirri and anal cirri most strongly pigmented, varying from yellow to brown, ventral cirri similar but more pale (Figure 2A). Preserved specimens lose pigment but the same patterns are faintly visible, especially in dorsal and anal cirri.

Distribution and habitat. Southeastern Australia from western Victoria to northern New South Wales. Intertidal to 3.5 m, from algal turfs (Figure 1A).

Remarks. There is no doubt that this species belongs to *Clavadoce* as first recognised by Banse (1973):

obliquely oriented ventral cirri, 3 fusiform antennae and uniramous parapodia are sufficient to confirm the generic placement. *Clavadoce* and *Notophyllum* are similar in having obliquely oriented ventral cirri, 3 fusiform antennae. *Clavadoce* is distinguished by having uniramous parapodia but the absence of a notopodial aciculum (and the presence of the structure in *Notophyllum*) is difficult to observe, especially without damage to the specimens which have fragile parapodial appendages. *Notophyllum*, however, is also distinguished by the nuchal lobes, lateral rows of enlarged papillae on the pharynx and much larger dorsal cirri covering much of the dorsum (Kato and Pleijel 2002).

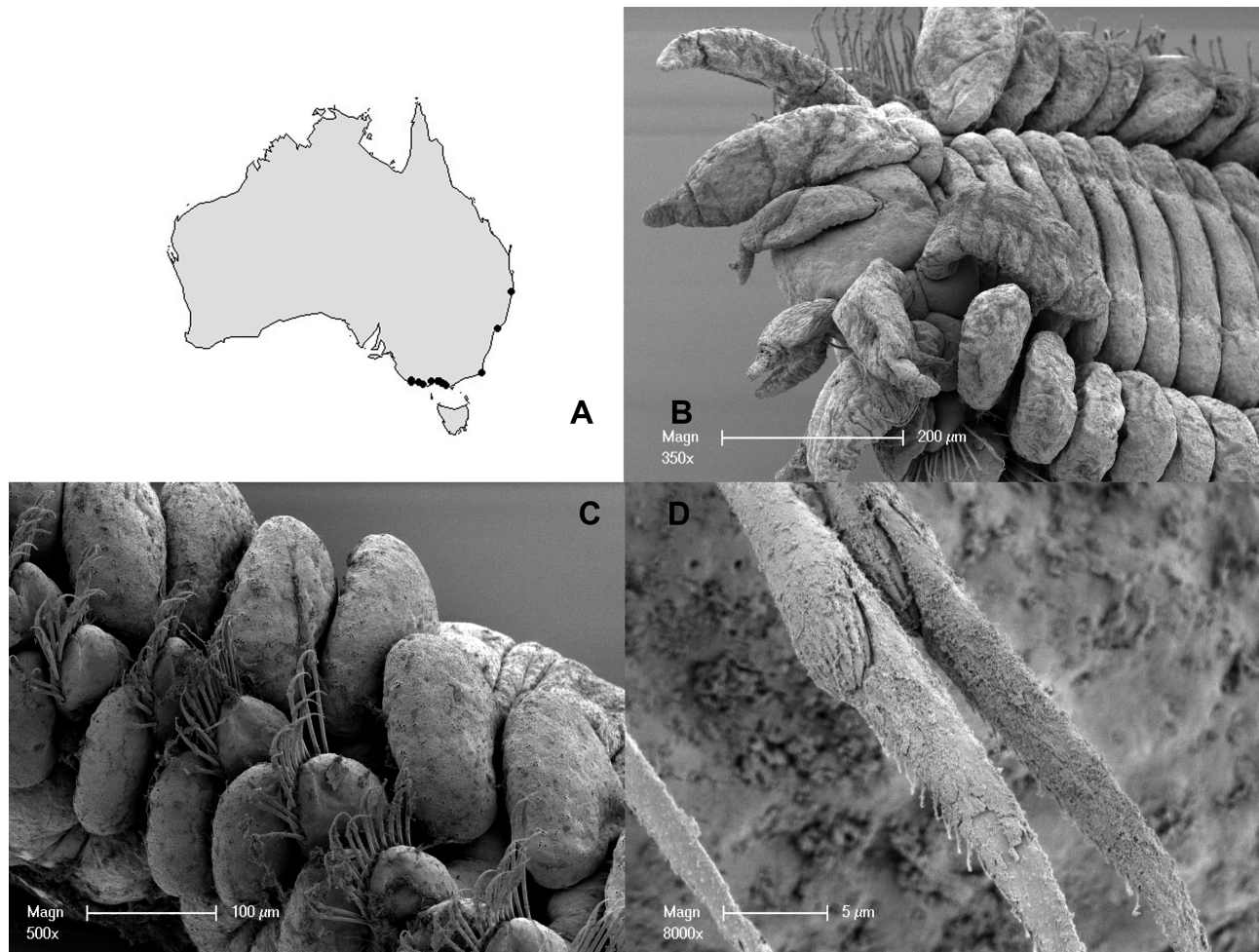


FIGURE 1. *Clavadoce dorsolobata* (Hartmann-Schröder, 1987): A, locations where *Clavadoce dorsolobata* specimens are known; B, SEM anterior end, MV F166895; C, SEM parapodia, chaetigers 26–28, MV F166897; D, neurochaetae, chaetiger 17, MV F166897.

Our material agrees closely with the figures and description of Hartmann-Schröder (1987) and with the type material. The availability of colour photographs and two specimens with everted pharynx has allowed us to provide a more complete description of the species. The dorsal raised areas on dorsum near the base of the dorsal cirri were observed by Hartmann-Schröder (“... treten oberhalb der Parapodien längliche Lappen auf”) Hartmann-Schröder (1987, p.31) and is visible in most of our specimens (Figure 2B, arrows). This structure is easiest to see in photographs of living material where brown pigment helps to distinguish the raised patch.

The neurochaetae of our material (Figure 2D) are as figured by Hartmann-Schröder (1987, p.64, figure 6). However the neurochaetae are also similar to other described species of *Clavadoce*, for example Blake (1997, Figure 4.13C, *C. splendida*; Figure 4.14C, *C. nigrimaculata*). Chaetal morphology apparently does not provide characters for distinguishing species of *Clavadoce*.

We have not re-examined the specimens reported by Hartmann-Schröder (1989; 1990) from northern NSW, but it is not plausible that Hartmann-Schröder would have misidentified this distinctive species so we do not doubt this northern extent of the range. *Clavadoce dorsolobata* is now known to be widespread in shallow water algal

turfs of southeastern Australia and is probably more common than the current limited records indicate. Even though *Clavadoce dorsolobata* is a small species and is easily overlooked, it is apparently absent from large MV collections of Phyllodocidae from southeastern Australia from shallow (5 m plus) and shelf depths, so it seems this species is confined to intertidal and shallow subtidal depths as indicated by the known specimens (Figure 1A).

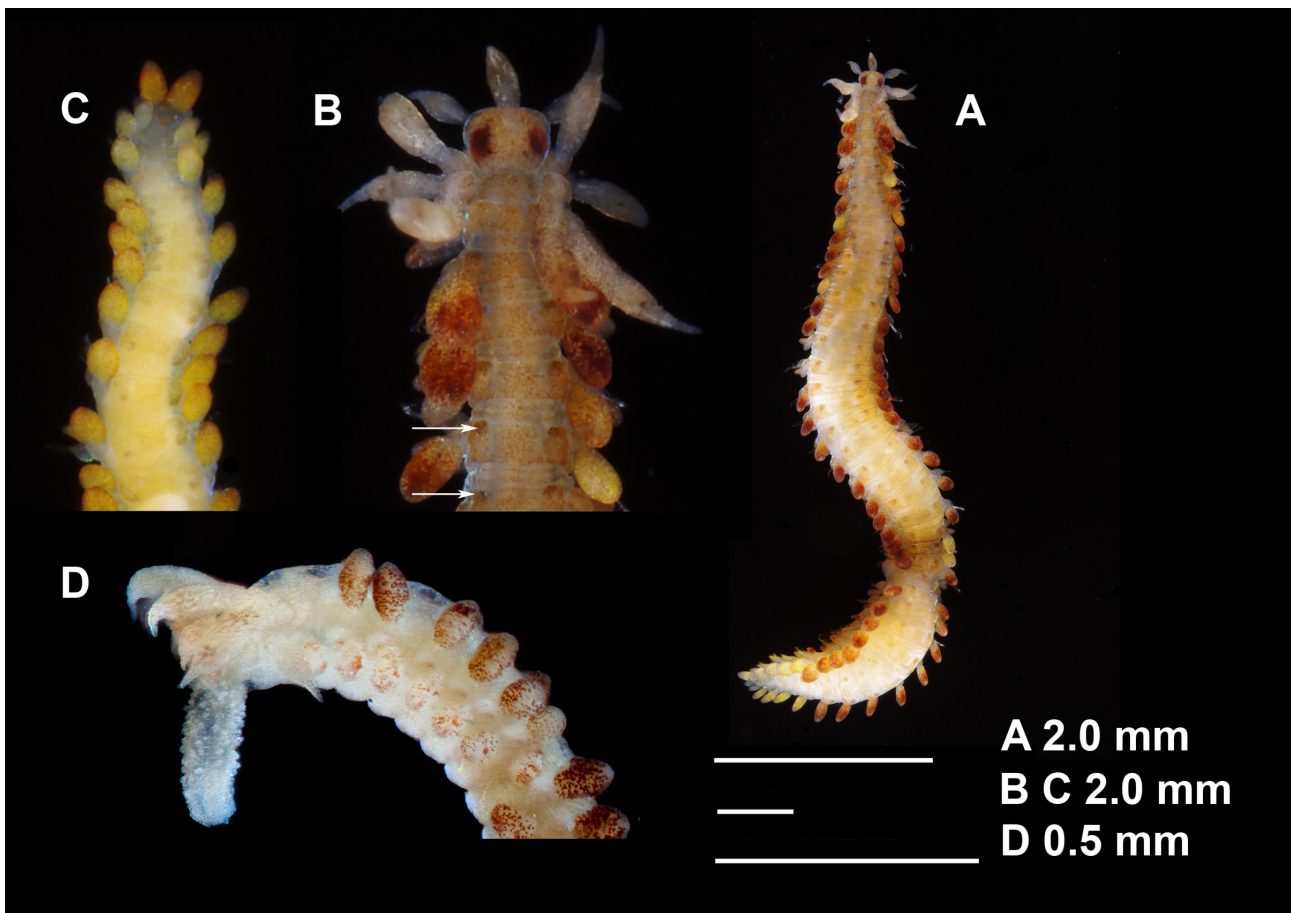


FIGURE 2. *Clavadoce dorsolobata* (Hartmann-Schöder, 1987): A, dorsal view, live specimen, MV F166896; B, dorsal view, anterior end, live specimen, MV F166896; C, dorsal view, pygidium and anal cirri, live specimen, MV F166894; D, lateral view, everted pharynx, fixed specimen, F166898; A, B, C: photographs Leon Altoff; D: photograph David Paul.

Discussion

Species of *Clavadoce* are easily recognised by the fusiform antennae and palps, widest at about mid-length and usually with distinctly narrowed tip section. Members of both genera also share the oblique orientation (relative to the aciculum) of the ventral cirrus and typical yellow-brown pigmentation, which is most conspicuous in live specimens but often remains even in preserved material. Species of *Nereiphylla* are similar but lack the median antenna. Species of *Notophyllum* are also similar and possess a median antenna but also have prominent nuchal lobes and other distinguishing features as discussed above.

Five species of *Clavadoce* are currently known and can be separated using the summary information in Table 1. Of the known species, none overlap in geographic range except *C. nigrimaculata* and *C. splendida* which occur in northern California but not at the same depths (Blake, 1988).

Acknowledgements

Leon Altoff, Audrey Falconer and T. Joan Hales (Marine Research Group, Field Naturalists Club of Victoria) collected and photographed much material of *C. dorsolobata* from Victoria. Karin Meißner facilitated access to

Hartmann-Schröder's material in ZMH. David Paul and Hugh MacIntosh (MV) assisted with additional photography of preserved specimens. SEM preparations and imaging was done with the assistance of Simon Crawford, School of Biosciences, The University of Melbourne. The manuscript was greatly improved thanks to the comments of anonymous referees.

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