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Pachycerianthus (Anthozoa: Ceriantharia: Cerianthidae), Two Newly Described Species from Port Jackson, Australia

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ABSTRACT. Two previously undescribed species of *Pachycerianthus* from Port Jackson are described. The species can be easily distinguished in the field on appearance. *Pachycerianthus delwynae* has distinctly banded marginal tentacles. *Pachycerianthus longistriatus* has distinctive longitudinal stripes on its marginals. Both species are found in sublittoral sandy mud in Port Jackson, often in close association with each other.

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Cerianthids are attenuated, solitary anemone-like anthozoans (Fig. 1a) with two series of tentacles in the crown and no pedal disc, which inhabit a soft tube made of layers of discarded nematocysts, sometimes encrusted with mud or sand (den Hartog, 1977).

Although cerianthids are considered common members of the benthic fauna of south-eastern Australia (Coleman, 1987; Shepherd & Thomas, 1982), knowledge of the taxonomy and morphology of Australian species is very poor. They have usually been designated as *Cerianthus* sp or *Cerianthus membranaceus* (Spallanzani), a Mediterranean species. There are four genera in the family Cerianthidae, *Cerianthus* Delle Chiaje, *Pachycerianthus* Roule, *Ceriantheopsis* Carlgren and *Ceriantheomorphe* Carlgren. The two species now described from Port Jackson, NSW, are assigned to the genus *Pachycerianthus*. This distinction is based on the presence of short, sterile mesenteries at m1 and b1 whereas *Cerianthus, Ceriantheopsis* and *Ceriantheomorphe* have fertile m1 and b1 mesenteries (Carlgren, 1912, 1931).

Materials and Methods

All animals were collected from Port Jackson by SCUBA diving. They were dug from the silt by hand and transported live to the Taronga Zoo Aquarium where they were placed in a 200 litre glass aquarium with fresh seawater flowing through at about five litres/minute.

Specimens were removed from their tubes and anaesthetised using MS222 (1g/litre), then fixed in 20% formalin buffered with excess hydrated magnesium sulphate. After fixing they were stored in 10% formalin solution, buffered with sea water. Contraction occurred during preservation, especially of the marginal tentacles.

Cnida were studied from paratype specimens from the collection of the Australian Museum. Wet squash preparations were made and studied under an interference contrast microscope using a magnification of 800 × (oil immersion 100 ×, ocular 8 ×). Measurements were made with an ocular micrometer. Descriptions of the cnida and anatomy are based on those of den Hartog (1977).

A series of specimens, including the type material, has been deposited in the collection of the Australian Museum, Sydney.

Subclass: *Ceriantipatharia* van Beneden, 1898
Order: *Ceriantharia* Perrier
Suborder: *Spirularia* den Hartog, 1977
Family: *Cerianthidae* Milne-Edwards & Haime, 1852
Genus: *Pachycerianthus* Roule, 1904

Pachycerianthus delwynae n.sp.

Type material. HOLOTYPE: Port Jackson, Chowder Bay, muddy sand, 14 m, coll. S. Carter, 15 September 1989, AMG15399. PARATYPES (2 specimens): Port Jackson, Bottle & Glass Rocks, sandy mud, 5 m, coll. P. Watts, 13 July 1989, AMG15400; Bottle & Glass Rocks, amongst mussel shell debris, 7 m, coll. S. Carter, 20 July 1989, AMG15401. Additional material (1 specimen): Port Jackson, Manly pool, coll. Dr P. Groves, 31 December 1957, AMG15404.

Description. *Coloration of live animals.* Column purplish brown aborally, merging through dark to pale yellowish brown to dark brown just below oral disc. Marginal tentacles pale orange to reddish brown with indistinct pale or white bands. Labial tentacles pale yellowish brown to cream colour. The oral disc is purplish brown.

Coloration of preserved animals. Purple colour faded leaving overall brown coloration. Marginal tentacles still possess distinct pale bands. Labials are pale yellowish brown.

Length in preservative. 50–240 mm.

Tentacles. Formula for arrangement of tentacles into pseudocycles are: marginal tentacles, 1(dt)2314. 2314.2314... ; labial tentacles, 2(dt)413.4231. 4312.4312... or 1(dt)341.4231.4312... In each crown, division into pseudo-cycles is difficult in some specimens. Directive labial tentacle (dt) is present. Marginal tentacles number 89–114 (type 110). Labial tentacles number 89–112. When animal not actively feeding, but still extended from tube, distal half to one third of marginal tentacles hang limply with distal quarter coiled loosely. This distal quarter remains coiled when animal withdraws into its tube.

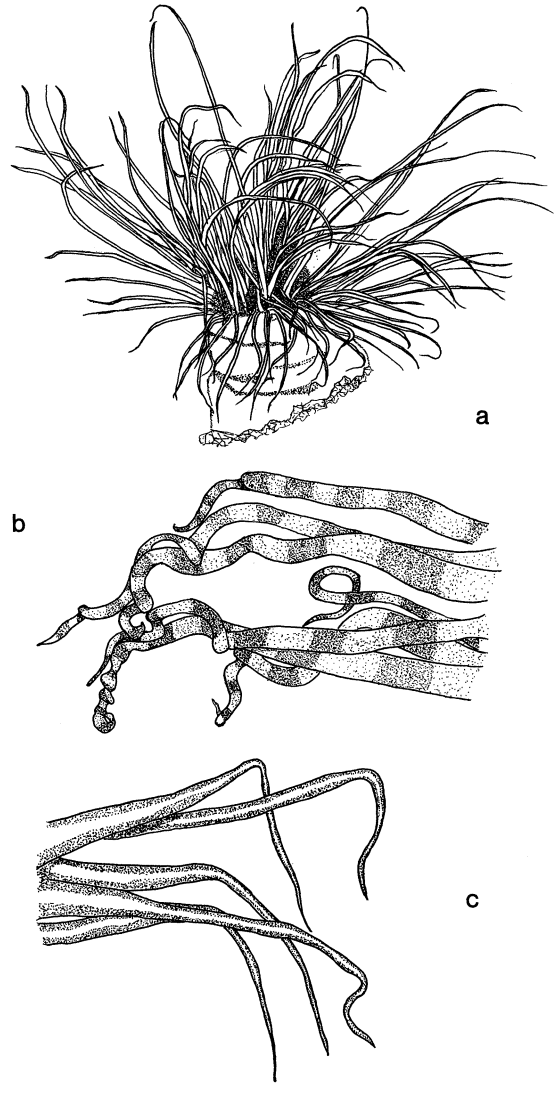

Fig. 1. a – Generalised view of organism; b – *Pachycerianthus delwynae* showing distinctive markings and coiled tentacles; c – *Pachycerianthus longistriatus* showing distinctive markings on the tentacles.

Siphonoglyph. Running two-thirds length of actinopharynx. Attached mesenteries 6 or 7 (7 in type). Hyposulcus well developed, reaching one fifth length of siphonoglyph. Hemisulcus distinct, continuing down directive tentacle.

Mesenteries. Directive mesenteries (B1) shorter than siphonoglyph; lengths of mesenteries may differ in same animal. Second mesenteries (m1) sterile, more than twice length of directives. Ciliated tract runs whole length of m1 and a few craspedonemes occupy aboral end. Third mesentery (b1) sterile, 1–1.5 × length of m1. Cnidoglandular tract found on distal half, a few craspedonemes may be present on distal end of b1 mesentery.

Mesenterial arrangement is BmbM. All macromesenteries (M, m) fertile, all micromesenteries (B, b) infertile. M1 long, but never reaches aboral pole. Three quarters to all of M1 occupied by ciliated tract and distal three quarters possess craspedonemes. The m1 mesenteries less than half length of M1 with ciliated tract running length of mesentery, distal half with craspedonemes. M2 longer or shorter than M1 and may reach aboral pole. Ciliated tract occupies nearly entire length of M2. After second quartette, M mesenteries reduced in length toward reproductive chamber, m mesenteries all of similar length. Micromesenteries usually very short. B1 usually similar in length to directive mesentery with b1 being half the length of B1. All the micromesenteries carry considerable amounts of cnidoglandular tract. After second quartette, micromesenteries vary little in length (Fig. 2).

Cnidom. Spirocysts, atrichs, homotrichs and spirulae of several types are present. The measurements were taken from 20 cnida for each type from three samples (n = 60) from two paratype specimens. All cnida are considered numerous and common unless specified.

	Length (range)			Width (range) mm	
Marginals					
Spirocysts	48.1	(34.4–56.2)	×	5.6	(3.1–9.4)
Spirula 2	65.6	(59.3–75.0)	×	8.4	(6.3–9.4)
Spirula	26.6	(25.0–28.1)	×	2.4	(1.6–3.1)
Atrich (uncommon)	59.4	(51.6–68.8)	×	7.8	(4.7–9.4)
Column					
Homotrich	53.1	(46.9–62.5)	×	15.9	(7.8–21.9)
Atrich	36.9	(25.0–46.9)	×	10.9	(4.7–21.9)
Spirula 2	42.2	(40.6–43.8)	×	5.0	(3.1–6.3)
Spirula 2	45.3	(40.6–50.0)	×	7.8	(6.3–9.4)
Labials					
Spirula 2	53.1	(50.0–54.2)	×	7.8	(6.3–9.4)
Spirocyst	43.4	(25.0–53.1)	×	5.6	(1.6–9.4)
Atrich (uncommon)	32.2	(25.0–40.6)	×	9.4	(6.2–12.5)
Spirula 2	35.3	(31.2–37.5)	×	5.6	(4.7–6.3)
Craspedonemes					
Atrich	62.5	(43.8–71.9)	×	19.7	(9.4–25.0)
Spirula 2	51.6	(43.8–68.8)	×	8.6	(7.8–9.4)
Spirocyst	24.1	(21.9–28.2)	×	3.8	(3.1–4.7)
Spirula 2	41.2	(37.5–46.9)	×	6.3	(3.1–9.4)
Simple Chord					
Spirula 2	28.1	(25.0–31.3)	×	7.8	(6.3–9.4)
Spirocyst	37.5	(36.1–39.2)	×	4.7	(4.0–5.1)
Spirula 2	26.3	(25.0–28.1)	×	6.3	(6.3–9.4)
Actinopharynx					
Spirula 2	45.9	(43.8–46.9)	×	7.2	(6.3–7.8)
Atrich	50.9	(40.6–68.8)	×	13.4	(6.3–25.0)
Spirula 2	31.0	(25.4–33.8)	×	4.7	(3.2–5.0)

Spirocysts appear to be absent from the column and the actinopharynx. The classes of spirulae could be separated on the length of the shaft in relation to the total capsule length. Spirulae 2 is the most common type, found in all tissue except the single chord of filament. Atrichs were found in all organs except the single chord and were uncommon in the labial and marginal tentacle tips. Homotrichs appear to be confined to the column.

Biology. Specimens were all collected from, or observed in, sand and/or muddy sediments, often with overlying banks of mussel shell (*Mytilus* sp) detritus or among parchment worm (*Diopatra dentata*) colonies. Depth range varied from three to over 15 m. The tubes rarely protruded more than three centimeters above the substrate. Several specimens have been collected with large numbers of the commensal worm, *Phoronis australis*, living in the tube walls. Coleman (1987) reported the presence of a commensal shrimp *Periclemenes holthuisi* and crab *Lissocarcinus* sp in association with an unidentified cerianthid which appears to be similar to *Pachycerianthus delwynae*.

Specimens viewed in an aquarium or in their natural habitat were rarely active unless light levels were low, suggesting that *P. delwynae* is crepuscular.

Remarks. *Pachycerianthus delwynae* possesses a directive labial tentacle, M1 never reaches the aboral pole and M2 may be longer than M1. M mesenteries are much longer than m mesenteries. The distinctive banded marginal tentacles are commonly coiled when relaxed (Fig. 1b). These features distinguish *P. delwynae* from the other known species of *Pachycerianthus*.

Etymology. *Pachycerianthus delwynae* is named after Ms Delwyn Hunt for her support and assistance during this study.

Pachycerianthus longistriatus n.sp.

Type material. HOLOTYPE: Taylors Bay, Port Jackson, silt over mussel debris, 5 m, coll. P. Watts, 20 July 1989, AMG15402. PARATYPES: Chowder Bay, Port Jackson, silt, 10 m, coll. S. Carter, 15 September 1989, AMG15403; Port Jackson, Old Collection, c. 1886, 1 specimen, AMG12553; Port Jackson, Old Collection, 3 specimens, G12554; Port Jackson, Old Collection, 1 specimen, AMG12555; Dawes Point, Port Jackson, 5–6 fathoms, bucket dredge, coll. W.J. Hale, January 1933, AM G13558–G13561; Drummoyne, 3 August 1963, 2 specimens, AMG15405; off Dawes Point, Port Jackson, 1933, coll. W.J. Hale, AMG15406.

Description. *Coloration of live animals.* Column purple aborally merging to brown orally. Brown coloration may vary from dark to pale yellowish brown. Marginal tentacles all have a pale longitudinal stripe on each side with oral and aboral faces coloured, which gives them a distinctly striped appearance. Two tentacle colour forms: one pale yellowish brown the other deep purplish maroon. Labial tentacles pale cream. Oral disc deep brown in colour.

Coloration of preserved animals. Purple colour faded leaving column brown overall. Marginal tentacles, of the pale yellowish-brown colour form, fade to a pale cream, leaving stripes faintly visible. Maroon form retains faded purplish coloration. Labial tentacles almost white.

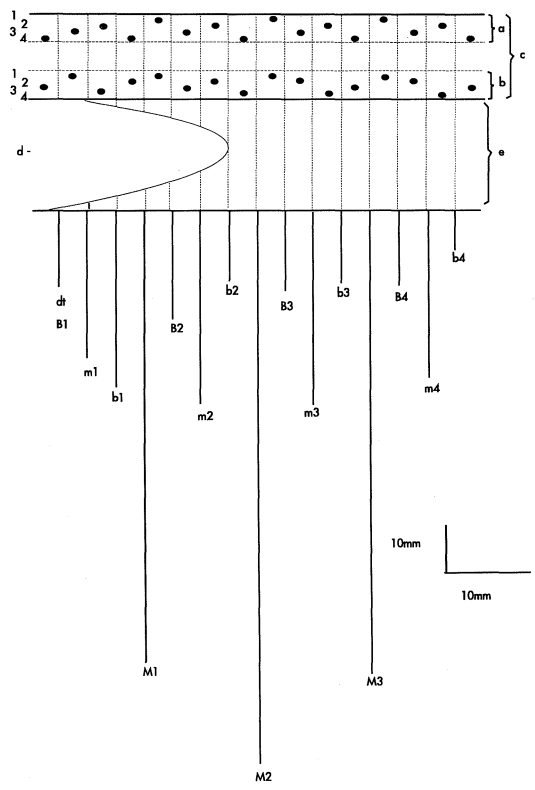

Fig. 2. Diagrammatic representation showing the right half of the internal arrangement of *Pachycerianthus delwynae*, cut longitudinally and pinned flat. a – marginal tentacle bases, b – labial tentacle bases, c – oral disc, d – siphonoglyph, e – actinopharynx, f – hemisulcus, g – protomesenteries, h – first quartette of metamesenteries.

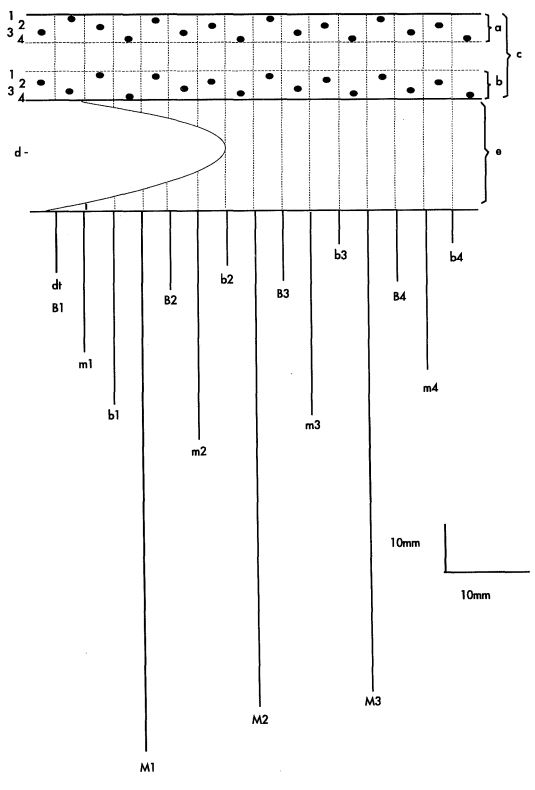

Fig. 3. Diagrammatic representation showing the right half of the internal arrangement of *Pachycerianthus longistriatus*, cut longitudinally and pinned flat. For explanation of key, see Figure 2.

Length in preservative. 70–220 mm.

Tentacles. Arrangement of tentacles in pseudocycles: marginal tentacles, 2(dt)431.4231.4231... ; labial tentacles, 3(dt)241.4231.4231... cycles 2 and 3 very difficult to separate. Directive labial tentacle present. Marginal tentacles number 138–140 (type 140), labial tentacles number 130–139 (type 138). Some marginal tentacles may be damaged at some time during animal's life and during regeneration a second tentacle may develop from a single tentacle base. When not actively feeding or in still water, distal third of marginal tentacles hang limply (Fig. 1c).

Siphonoglyph. Runs complete length of actinopharynx. Six attached mesenteries. Hyposulcus well developed, reaching one fifth length of siphonoglyph. Hemisulcus distinct but short.

Mesenteries. The directive mesenteries (B1) are short and may differ in length; m1 sterile, 1.5–3 × length of directives. Ciliated tract runs entire length of m1, craspedonemes may be present at distal end; b1 is 1–1.5 × length of m1. Ciliated tract runs entire length of b1, craspedonemes may be present along distal half and cnidoglandular tract may be found at aboral tip of mesentery.

Mesenterial arrangement BmbM. All macromesenteries (M, m), except m1, are fertile, all micromesenteries (B, b) infertile. M1 long, reaching to aboral pole. M2 and M3 also long, almost reaching to aboral pole. Half to two-thirds of M1 occupied by ciliated tract and distal three-quarters carries craspedonemes. The m1 mesenteries less than half length of M1, ciliated tract confined to proximal three-quarters. Slight reduction in length of m mesenteries as they approach multiplication chamber. M mesenteries undergo substantial reduction in length after second quartette. Micromesenteries generally very short, B mesenteries twice length of b. All micromesenteries possess cnidoglandular tract. After first quartette, micromesenteries vary little in length (Fig. 3).

Cnidom. Spirocysts, spirulae, atrichs and homotrichs are present. Cnida were examined and measured in two paratype specimens with ten capsules of each type measured from three samples (n = 60).

	Length (range)			Width (range) mm	
Marginals					
Spirocyst	44.1	(21.9–60.9)	×	5.3	(1.6–9.4)
Spirula 2	53.1	(50.0–56.3)	×	5.9	(4.7–6.3)
Spirula 2	52.2	(46.9–56.3)	×	8.4	(7.8–9.4)
Spirula 1	32.8	(31.3–34.4)	×	5.5	(4.7–6.3)
Column					
Homotrich	48.4	(46.9–50.5)	×	15.6	(15.6–16.5)
Atrich	71.9	(56.3–90.1)	×	25.3	(15.6–31.3)
Atrich	40.0	(37.5–43.8)	×	5.3	(3.2–6.4)
Spirula 2	27.2	(25.0–28.2)	×	5.3	(4.7–6.3)
Spirula 2	36.5	(34.4–37.5)	×	7.8	(6.3–9.4)
Labials					
Spirula 2	43.8	(31.3–53.2)	×	10.3	(7.8–12.5)
Spirocyst	41.1	(29.7–53.2)	×	4.4	(1.6–7.8)
Atrich (uncommon)	37.5	(28.1–40.6)	×	7.5	(6.3–9.4)
Spirula 2	35.9	(34.4–37.5)	×	4.7	(3.2–6.3)
Craspedonemes					
Atrich	43.8	(37.5–53.1)	×	6.3	(4.7–9.4)
Spirula 2	32.2	(28.1–37.5)	×	6.3	(4.7–7.8)
Spirocyst	30.0	(18.9–37.5)	×	5.3	(3.2–7.8)
Simple Chord					
Atrich	36.3	(34.4–37.5)	×	5.3	(3.2–6.3)
Spirocyst	45.6	(37.5–56.3)	×	4.1	(1.6–6.3)
Spirula 2	44.3	(37.5–53.1)	×	6.3	(4.7–9.4)
Actinopharynx					
Atrich	43.8	(40.6–46.9)	×	5.9	(3.1–7.8)
Spirocyst	52.5	(46.9–59.4)	×	5.3	(3.1–7.8)
Spirula 2	42.5	(37.5–46.9)	×	5.0	(3.1–7.8)
Spirula 2	33.1	(28.1–37.5)	×	4.4	(3.1–6.3)

Atrichs are absent in the marginal tentacles and uncommon in the labial tentacles and homotrichs are confined to the column. Spirocysts were found in all organs except the column. Spirulae classes were generally restricted to two, with type 2 spirulae the most common in all tissues except the simple chord in the filaments.

Biology. This species occupies the same habitat as *P. delwynae*, often living in close proximity. Similar commensal organisms are found associated with both species. One specimen has been kept on display at Taronga Aquarium for 21 years, during which time it has once produced offspring (J. West, pers. comm.), unfortunately the method of reproduction was not reported.

Remarks. *Pachycerianthus longistriatus* has M1 reaching the aboral pole, M2 and M3 almost reaching the aboral pole and m1 only being half the length of M1. A directive labial tentacle is present. M1 mesentery is short. These stable characters distinguish *P. longistriatus* from other species of *Pachycerianthus*.

Etymology. The specific name *longistriatus* describes the longitudinal stripes on the marginal tentacles (Fig. 1c).

Discussion

There are now 14 known species of *Pachycerianthus* (Arai, 1965; den Hartog, 1977; Uchida, 1979) (Table 1).

Pachycerianthus delwynae n.sp. and *P. longistriatus* n.sp. can easily be separated from each other on external appearance.

Pachycerianthus delwynae has distinctive white or pale bands on pale orange to reddish brown marginal tentacles which, when relaxed, become coiled at the tips. The distinctive coiling at the tips was also reported in *Arachnanthus nocturnus* (den Hartog, 1977) and explained as a reaction to photoflash and Arai (1972) induced the response in *P. fimbriatus* by tactile stimulus. However, continual daily observations of *P. delwynae* under different light conditions in aquaria and regular observation of specimens in the field over a two year period leads to the acceptance of the coiling of the tentacle tips as a normal behaviour. At no time during the same period was *P. longistriatus* observed with coiled tentacles.

Pachycerianthus longistriatus has distinct stripes along the length of the marginal tentacles, which range in colour from a soft pale yellowish brown to a deep purple maroon. The sides of the tentacles are usually paler in colour.

In both species the coloration of the tentacles is consistent in all specimens collected and in several observed in the field but not collected.

In *P. delwynae*, M2 may be longer than M1 and M1 does not reach the aboral pole. In *P. longistriatus*, M1 reaches the aboral pole and M2 and M3 mesenteries are almost as long as M1. *Pachycerianthus delwynae* has m mesenteries less than half the length of M mesenteries and *P. longistriatus* has m mesenteries half the length of M mesenteries. Both species possess a labial directive tentacle and m1 is short in both (Table 1), between 1.5–3.0 × the length of the directive tentacle.

Pachycerianthus delwynae and *P. longistriatus* are similar to five described species of *Pachycerianthus*, *P. aestuari* (Torrey & Kleeberger, 1909), *P. fimbriatus* McMurrich, 1910 (= *P. plicatus* Carlgren, 1924), *P. magnus* (Nakamoto, 1919), *P. monostichus* McMurrich, 1910 and *P. solitarius* (Rapp, 1829) (= *P. bicyclus* [Torelli, 1961]) in having a labial directive tentacle (Table 1). Of these, *P. aestuari* and *P. solitarius* differ in having m mesenteries of almost the same length as the M mesenteries, whereas, in both of the new species they are less than half the length. *Pachycerianthus fimbriatus*, *P. curacaoensis* den Hartog, 1977 and *P. magnus* differ from both of the new species in having M1 mesenteries much longer than all other M mesenteries. In *P. delwynae*, M2 is longer than M1 and in *P. longistriatus* M2 is almost as long as M1. *Pachycerianthus longistriatus* also has only six attached mesenteries where *P. fimbriatus* has 8–12. The remaining species with a labial directive tentacle, *P. monostichus,* has a very long m1 mesentery and the marginal tentacles are arranged in two pseudocycles as opposed to short m1

mesenteries and four pseudocycles of marginal tentacles in the two new species.

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Table 1. Comparison of characters of some species of *Pachycerianthus*.

Species	dt B1	M1 length	M2 length	m1 length	m2 length	Attached mesentery	siphonoglyph
aestuari	yes	to aboral		v.short	= M	16	v.broad
benedeni	no	to aboral	<<M1	short	short		v.broad
curacaoensis	yes	to aboral	<1/2M1	long	< m1		narrow
delwynae n. sp.	yes	~to aboral	> M1	short	<1/2M	6, 7	narrow
dorhni	no			long			
fimbriatus	yes	to aboral	<<M1	short	1/3M	8, 10–12	broad
insignis	no	~to aboral	= M1		= M		
johnsoni	no	to aboral	<<M1		short	8	broad
longistriatus n. sp.	yes	to aboral	= M1	short	<1/2M1	6	broad
magnus	yes	not to aboral	1/2M1	short	1/2M1	6	narrow
maua	no	~to aboral	<<M1	short	short	6	narrow
monostichus	yes	to aboral	< M1	v.long		0	broad
multiplicatus	no	to aboral	= M1	short	= P2	6	narrow
solitarius	yes	to aboral	≅ M1	short	= M	6	broad