

A new species of tube-dwelling anemone (Cnidaria, Anthozoa, Ceriantharia, *Ceriantheopsis*) from the Warm Temperate South-western Atlantic

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A new species of tube-dwelling anemone of the genus Ceriantheopsis (Cnidaria: Ceriantharia), Ceriantheopsis lineata sp. nov., is described and can be found in fine sand or mud in the sublittoral zone (0–200 m) from Argentina to Brazil (Warm Temperate South-western Atlantic). This new species is distinguished from its congeners by a number of features, however some characters (directive tentacles, line on tentacles and length of P₂) allow a conclusive identification among the other Ceriantheopsis species.

Keywords: Atlantic Ocean, taxonomy, Anthozoa

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INTRODUCTION

Tube-dwelling anemones (Anthozoa: Ceriantharia) are organisms that live in benthic marine communities either in shallow or deep waters (Carlgren, 1912). The tubes produced by these animals vary between Ceriantharia groups and apparently are related to the habit of the species (Stampar *et al.*, 2015). Due to a number of morphological and molecular features outlined in den Hartog (1977) and Stampar *et al.* (2014a), the subclass Ceriantharia is divided in two clades: Penicilaria and Spirularia. The most peculiar group within Spirularia is the family Cerianthidae Milne-Edwards & Haime, 1852, that is defined by lacking specialized nematocyst-bearing internal structures called acontoids or cnidorages (den Hartog, 1977). This family is composed of four genera known from adults and larvae (*Ceriantheomorpha* Carlgren, 1931, *Ceriantheopsis* Carlgren, 1912, *Cerianthus* Delle Chiaje, 1841 and *Pachycerianthus* Roule, 1904), and several ‘genera’ known only from larval forms (Tiffon, 1987; Daly *et al.*, 2007).

The genus *Ceriantheopsis* was described based on *Ceriantheopsis americana* (Agassiz in Verrill, 1864), a species found in large numbers in some areas of the USA Atlantic Coast (Shepard *et al.*, 1986). There are only two other described species, *C. austroafricana* Molodtsova *et al.*, 2011 and *C. nikitai* Molodtsova, 2001, both from the

Atlantic coast of the African continent (Temperate Southern Africa Zone – cf. Spalding *et al.*, 2007) (Molodtsova *et al.*, 2011).

Within the Warm Temperate South-western Atlantic (after Spalding *et al.*, 2007) there is only one uncertain record of *Ceriantheopsis* (*Cerianthus americana*) by Hertwig (1882) from the Uruguayan coast. However, the identification of the specimen was only performed by examination of the external morphology, as the diagnostic characters for identification of genera and species are related to internal anatomy (see more in Molodtsova *et al.*, 2011; Stampar *et al.*, 2014b). For this geographic area there are also some Cerianthidae records without specific identification (see Scarabino, 2006).

The aim of this work is to describe a species of the genus *Ceriantheopsis* based on both morphology and anatomy of specimens collected in Argentina and Brazil, emphasizing that this is the first species of this genus for this biogeographic region (Warm Temperate South-western Atlantic).

MATERIALS AND METHODS

Specimens were collected by scuba diving from Quequén Port (two specimens), Buenos Aires province, in very thin grained and soft clay close to the northern breakwater (Escollera Norte), or obtained from dredging (Projeto Camarão – st 776) on the coast of Santa Catarina (one specimen), Brazil. Collected polyps were preserved in 4% seawater-buffered formaldehyde solution for morphological studies. Many

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additional photographic records noted based on images taken during regular scuba diving operations of the Laje Viva NGO (www.lajeviva.org.br) – COTEC 41097/2007 to delimit the shallow distributional area (less than 50 m). Comparative specimens from the American Museum of Natural History (AMNH) collection (*Ceriantheopsis americana*) and a specimen of *Ceriantheopsis austroafricana* collected in Cape Town (South Africa) were also examined. The holotype and one paratype were deposited in the cnidarian collection of Museu de Zoologia da Universidade de São Paulo (MZUSP).

Morphological study

The anatomical study of the polyps and cnidome was based on criteria defined by several authors (van Beneden, 1897; Carlgren, 1912; den Hartog, 1977; Tiffon, 1987; Stampar *et al.*, 2012). Two whole animals were cut apart through the ventral side (opposite to the siphonoglyph) using surgical scalpels, then the dissected polyp was fastened using acupuncture needles.

The classification of cnidae followed den Hartog (1977) and England (1991), but nomenclature was based solely on

Molodtsova *et al.* (2011). Thirty measurements (undischarged capsules) were taken from each cnida type out of each body region of the holotype and paratype specimens. The cnidome was analysed under a Nikon Eclipse 80i microscope with phase contrast. All parts of the body were analysed separately so that contamination would be avoided. The two parts of mesenterial filaments (cnidoglandular tract and ciliated tract) were analysed together using 30 measurements from each part. Cnidae that showed no overlap in sizes were tested via Mann–Whitney test in order to check the consistency of divergence between species. Four specimens of *Ceriantheopsis americana* (AMNH 730/AMNH 3451) from Jamaica and USA (Florida) and one specimen of *Ceriantheopsis austroafricana* from Cape Town, South Africa were also examined for comparison.

RESULTS AND DISCUSSION

SYSTEMATICS

Class ANTHOZOA Ehrenberg, 1834
Subclass CERIANTHARIA Perrier, 1883 (see details in



Fig. 1. *Ceriantheopsis lineata* sp. nov.: (A) Live image of the holotype from Quequén, Argentina (MZUSP 2686), (B) Live specimen at Laje de Santos, São Paulo, Brazil, image only (photo from Noeli Lara Ribeiro), (C) Live specimen at Laje de Santos, São Paulo, Brazil, image only (photo from Armando de Luca Jr) and (D) Live specimen from off Paranaguá, Paraná, Brazil, image only (photo from Marcelo Krause) and (E) General view of the holotype in the long tube (MZUSP 2686).

Stampar *et al.*, 2014a)
 Suborder SPIRULARIA den Hartog, 1977
 Family CERIANTHIDAE Milne Edwards & Haime, 1852
 Genus *Ceriantheopsis* Carlgren, 1912

Type species – *Ceriantheopsis americana* (Agassiz in Verrill, 1864) by subsequent designation (Carlgren, 1912: p. 24).

Distribution: The genus is restricted to the Atlantic Ocean (Caribbean Sea, Gulf of Mexico, US Coast and South Africa Coast).

Diagnosis Cerianthids with alternating sterile and fertile mesenteries. Second protomesenteries fertile, reaching aboral pole. Metamesenteries arranged in mBMb. Length of all but M-metamesenteries diminishes toward multiplication chamber. Length of M-metamesenteries of first 2–4 quartets can increase toward the multiplication chamber. M₃ and further mesenteries can diminish towards multiplication chamber (Carlgren, 1912).

Ceriantheopsis lineata sp. nov.

Figures 1–4

TYPE MATERIAL (2 SPECIMENS)

Holotype: MZUSP 2686, adult specimen (29 cm long), ~12 m depth, Quequén Port (38°34'41.39"S, 58°41'49.80"W), Quequén, Buenos Aires, Argentina, G. Pastorino coll.

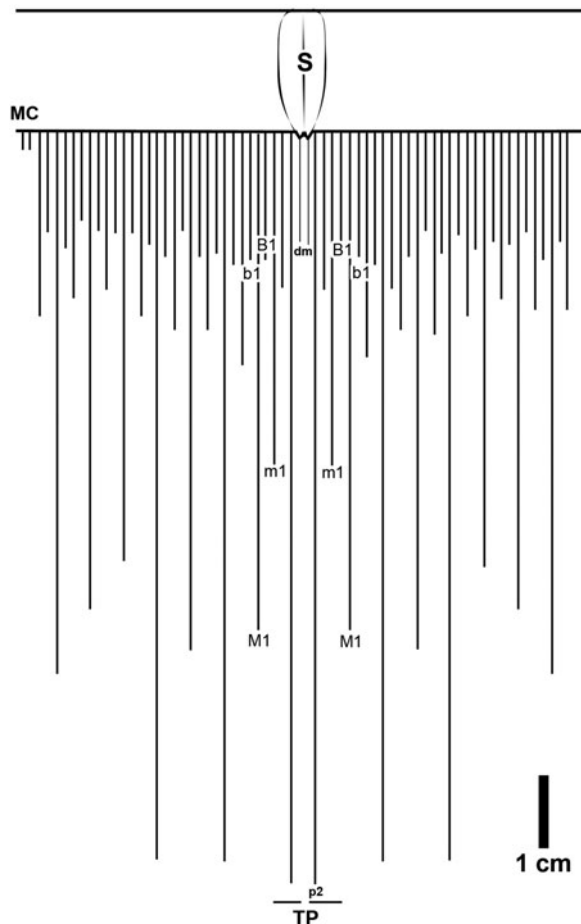


Fig. 2. Graphical representation of the arrangement of mesenteries *Ceriantheopsis lineata* sp. nov. MC, Multiplication chamber; dm – Directives, M – M-mesenteries, m – m-mesenteries, B – B-mesenteries, b – b-mesenteries, TP – Terminal pore and S – Siphonoglyph.

(10/xii/2008) (I). See pictures of the animal inside the tube (Figure 1E).

Paratype: MZUSP 2687, adult specimen (18 cm long), 130 m depth, offshore Joinville (26°19'00"S 47°00'00"W), Santa Catarina, Brazil, Projeto Camarão (st 776) coll. (12/xii/1969) (II).

COMPARATIVE MATERIAL EXAMINED

AMNH 730, *Ceriantheopsis americana*, Jamaica; AMNH 3451, *Ceriantheopsis americana*, USA (Florida). First author collection, *Ceriantheopsis austroafricana*, from Waterfront (33°54'29"S 18°25'6"E) (10/v/2013), 8 m, Cape Town, South Africa.

DIAGNOSIS

Marginal tentacles with a dark longitudinal line. Two mesenteries attached to siphonoglyph, absence of directive labial tentacle and four types of microbasic b-mastigophores.

Description (based on MZUSP 2686 and 2687 specimens)

Long (up to 300 mm long) and thin (10–20 mm width) cerianthid; 48–68 brown, purple or green marginal tentacles (40–45 mm in preserved specimens), one dark line over tentacle length (Figure 1), arrangement 1212.1212.1212, with more than 8 pores per tentacle, unpaired labial tentacle absent; 40–60 brown to purple labial tentacles (up to 10 mm long in preserved specimens), arrangement 4231.4231.4231, unpaired labial tentacle absent; pleated stomodeum extending over 1/5 to 1/6 of total body length, hyposulcus 5 mm long, hemisulci distinct; siphonoglyph narrow, connected only to directives; free part of sterile directive mesenteries almost the same length of siphonoglyph, without mesenterial filament. Second protomesenteries almost reaching aboral pole, fertile, bearing ciliated tract with bundle of craspedonemes, followed by very short cnido-glandular tract and long (~70% of the mesentery) craspedion tract. Third protomesenteries sterile, longer than half directives, with craspedonemes. M and m-metamesenteries long, fertile; M₁ reach 2/3 of total body length and M₂ reaching almost aboral pore (longer than M₁), with bundle of craspedonemes; B and b-mesenteries, sterile, with almost same length; see Figure 2 for schematic arrangement of mesenteries. The cnidome of the species (Figure 4) is composed of spirocysts, holotrics, microbasic b-mastigophores (four types) and ptychocysts distributed as shown in Table 1.

Distribution – from Argentina, Quequén (Buenos Aires) to Brazil, Laje de Santos (São Paulo) (Figure 3). The southernmost record is Quequén (Buenos Aires) and the northernmost record is from Laje de Santos, São Paulo state. On the coast of Argentina (higher latitudes) specimens can be observed at shallow waters (less than 10 m) in mud. Specimens from Brazil were recorded in much deeper areas (30–130 m) and coarser sediment (fine to medium sand).

Etymology – The specific name '*lineata*' (Latin *linea*), female, is an allusion to the longitudinal central line on marginal tentacles.

Colour variation – The colour of marginal tentacles vary from yellowish-brown to a deep purple or pale green but always with a dark longitudinal line. The labial tentacles are always very similar to predominant colour of marginal tentacles.

Tube symbiosis – Phoronida specimens were found on tubes of *Ceriantheopsis lineata* sp. nov., at Laje de Santos (Brazil), but not identified like the ones observed by Stampar *et al.* (2010) over *Ceriantheomorphe brasiliensis*. Other epizoid animals like the bryozoan colonies were not

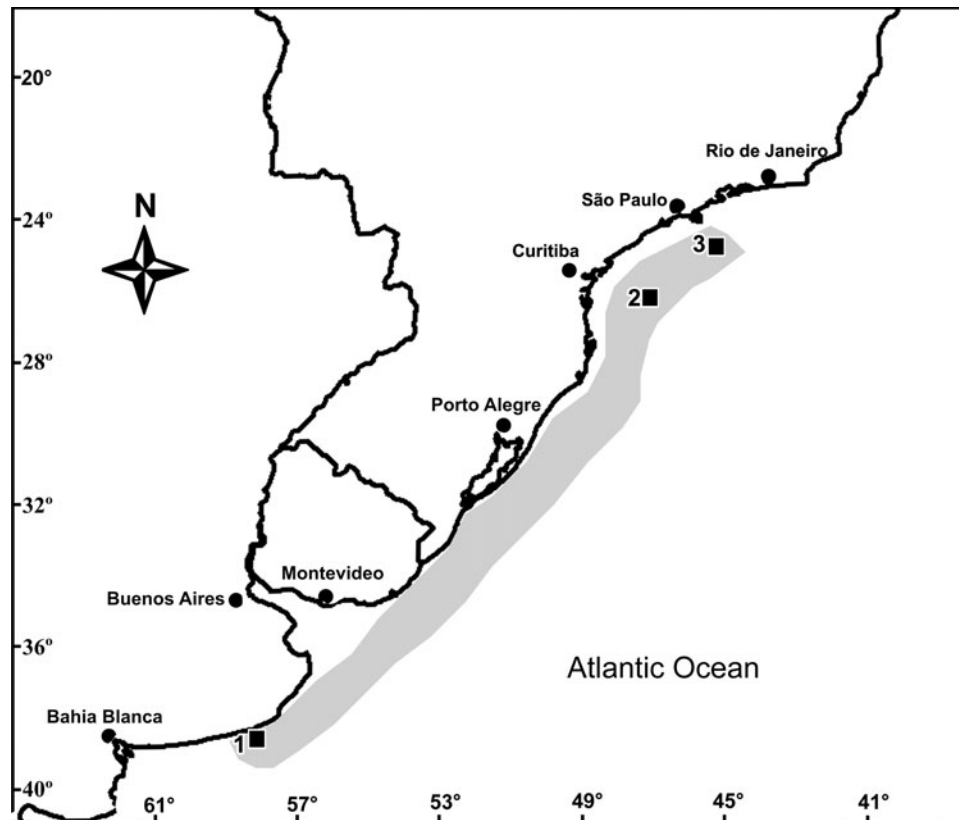


Fig. 3. Estimated distributional area of *Ceriantheopsis lineata* sp. nov. along the Warm Temperate South-western Atlantic (Grey line). 1 – Quequén, Argentina (Holotype); 2 – off Joinville (Paratype) and 3 – Laje de Santos, Brazil (photographic records).

found, as described by Vieira & Stampar (2014) for *Pachycerianthus schlenzae*.

Holotype description (MZUSP 2686) (Figures 1 & 2)

Elongated polyp, 28 cm long, 25 mm diameter just below marginal tentacles and 10 mm near aboral end. Marginal tentacles 67, arranged in two pseudocycles, 35–40 mm long and 6–5 mm in diameter near the base, brown with a darkish longitudinal line. The space between cycles of marginal and labial tentacles brown coloured. Labial tentacles 49, about 15 mm long, brown with a white longitudinal line, directive labial absent, arrangement of marginal tentacles 1212.1212.1212... and labial tentacles 4231.4231.4231... Oral disk 25 mm wide, stomodeum 60 mm long, light brown, siphonoglyph narrow and elongate with 2 mesenteries attached, hyposulcus 5 mm long with short hemisulci 2 mm long. Free part of directive mesenteries inconspicuous, without mesenterial filament. Second protomesenteries almost reach aboral pole, fertile, bearing ciliated tract with bundle of craspedonemes. Third protomesenteries sterile, longer than half directives, with craspedonemes. M and m-metamesenteries long, fertile; M_1 reach $2/3$ of total body length and M_2 reaching almost aboral pore (longer than M_1), with bundle of craspedonemes; B and b-mesenteries, sterile, with almost same length.

Morphological remarks

The observed specimens of *Ceriantheopsis lineata* sp. nov. varied much more on the colouration of tentacles than in

relation to internal anatomy. The mesenteries have the same size ratio in relation to column length of the observed specimen. The small specimen (MZUSP 2687) has fewer mesenteries and tentacles. The mesenterial filaments have from 0.5 to 5 mm in length and these are always arranged in the upper region of the mesentery. The amount of these structures varies greatly between mesenteries of the same type in the same specimen. The single paratype has different column length in relation to holotype; however the ratio between the length of mesenteries and column length is the same. The arrangement of the tentacles was also constant in both observed specimens.

Some specimens were taken out from the tube and maintained alive during several days in laboratory inside an artificial tube (PVC) where the animal reconstructed the tube in less than 2 days. It is consistent with information about the reconstruction of the tube of *Ceriantheomorpha brasiliensis* (see more in Stampar *et al.*, 2015).

Comparison with other *Ceriantheopsis* species

MORPHOLOGICAL ASPECTS

A review of the three species of the genus was recently performed by Molodtsova *et al.* (2011), and a comparison of *Ceriantheopsis lineata* sp. nov. is possible. With this new species, the genus *Ceriantheopsis* again confirmed to be restricted to Atlantic waters, two species occurring in the African coast and other two from the American coast.

The first morphological trait that was possible to compare is the number of marginal tentacles. Based on this feature there are two different observed patterns; more than 100

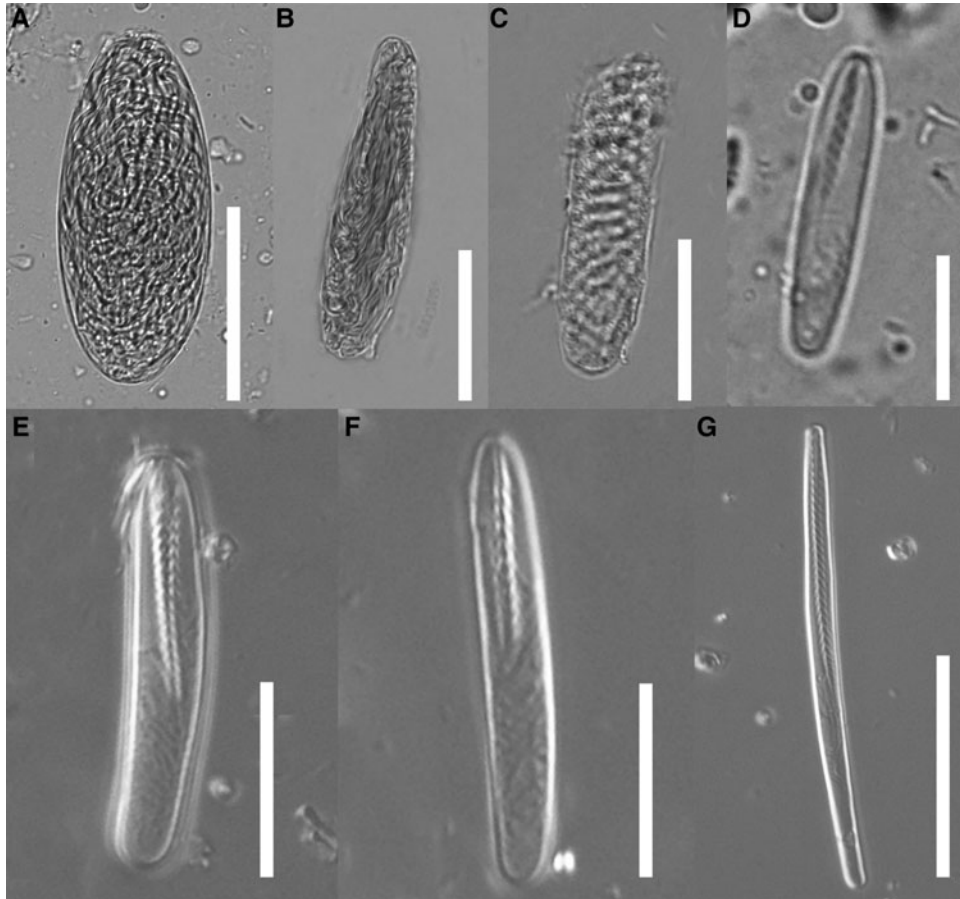


Fig. 4. Cnidome of *Ceriantheopsis lineata* sp. nov. (A) ptychocysts I, scale bar 40 μm ; (B) ptychocysts II, scale bar 20 μm ; (C) holotrachs, scale bar 20 μm ; (D) microbasic b-mastigophores I, scale bar 15 μm ; (E) microbasic b-mastigophores II, scale bar 18 μm ; (F) microbasic b-mastigophores III, scale bar 16 μm ; (G) microbasic b-mastigophores VI, scale bar 30 μm .

(*C. americana*) and fewer than 70 (other three species) tentacles. A second character that can be used to distinguish species is the presence of directive labial tentacle. This feature is observed in all species of *Ceriantheopsis*, except *C. lineata*

sp. nov. (Table 2). Another interesting characteristic is the number of mesenteries attached to the siphonoglyph region. *Ceriantheopsis lineata* sp. nov. has only 2 mesenteries while all other species have 4 mesenteries attached to the

Table 1. Cnidome of *Ceriantheopsis lineata* sp. nov. based on two specimens, the holotype (MZUSP 2686) and paratype (MZUSP 2687); data based on 30 measurements of each type, values are presented as the mean and range in parentheses.

		Length (μm)	Width (μm)
COLUMN	Ptychocysts I	88.65 (84–93.6)	31.86 (25.2–34.8)
	Ptychocysts II	65.73 (61.8–69.6)	15.15 (15–15.6)
	Holotrachs	37.92 (36–39.6)	7.2 (7.2)
	b-mastigophores I	30.6 (27.6–35.4)	4.98 (4.8–6)
MARGINAL TENTACLES	b-mastigophores II	35.16 (31.2–37.2)	5.94 (5.4–6)
	b-mastigophores I	28.98 (24–31.2)	4.8 (4.8)
	b-mastigophores II	35.16 (31.2–37.2)	5.94 (5.4–6)
LABIAL TENTACLES	b-mastigophores VI	59 (54–65.4)	2.56 (2.4–3)
	b-mastigophores I	34.3 (30–40.2)	6 (6)
	b-mastigophores II	25.68 (25.2–27)	3.54 (3–3.6)
CNIDO-GLANDULAR TRACT	b-mastigophores III	32.16 (29.4–34.8)	4.8 (4.8)
	b-mastigophores I	25.5 (24.6–27)	6 (6)
	b-mastigophores II	22.92 (21.6–24.6)	3.6 (3.6)
ACTINOPHARYNX	b-mastigophores III	17.1 (15.6–18.6)	3.6 (3.6)
	b-mastigophores I	41.94 (39.6–44.4)	6 (6)
	b-mastigophores II	31.56 (29.4–33.6)	3.6 (3.6)
	b-mastigophores III	23.34 (22.8–24.6)	4.92 (4.8–5.4)
	Holotrachs	41.3 (38–43.34)	8.3 (7–8.6)

Table 2. Comparison of anatomical features of the valid species of *Ceriantheopsis* (modified from Molodtsova et al., 2011).

	<i>C. americana</i>	<i>C. nikitai</i>	<i>C. austroafricana</i>	<i>C. lineata</i> sp. nov.
Marginal tentacles	Up to 100–120	Up to 70	Up to 70	Up to 60
Directive labial tentacle	Present	Present	Present	Absent
Arrangement of labial tentacles	(2)413.4232.4312 (4)413.4231.4312.4312	(3)423.4232.4312.4312	(2)313.4343.4324.3124	4231.4231.4231.4231
Actinopharynx	1/12–1/8 of gastric cavity	1/5–1/4 of gastric cavity	1/10–1/8 of gastric cavity	1/6–1/5 of gastric cavity
Oral disc	0.7–1.0 cm	~0.6–0.7 cm	Wide, ~1.5 cm in preserved	1.0–1.5 cm in preserved
Siphonoglyph	Narrow, 4 mesenteries attached	Wide, 4 mesenteries attached	Wide, 4 mesenteries attached	Narrow, 2 mesenteries attached
Directive mesenteries	< Actinopharynx	~ Actinopharynx	~ Actinopharynx	< Actinopharynx
P ₂	To aboral pole	To aboral pole	To aboral pole	Almost to aboral pole
P ₃	= B	= B	= B	= B
M	> B	< 2B	> B	> B
M ₃	≤ M ₂	> M ₂	≤ M ₂	< Half M ₂
Cnido-glandular tract at fertile mesenteries of first quartets	Present	Not present	Present	Present
Craspedion tract at fertile mesenteries	6/7–8/9	3/5	6/7	~6/7–8/9
Cnido-glandular tract at B	≤ b	= b	< b	< b
Craspedonemes of craspedion at fertile mesenteries	Sometimes present	Absent	Absent	Absent

siphonoglyph (Table 2). The presence of an exclusive type of b-mastigophore (type VI) nematocyst can also be assigned as a defining character of *Ceriantheopsis lineata* sp. nov. (Table 2).

Nomenclatural remarks

As previously mentioned, the genus *Ceriantheopsis* was created by Carlgren, 1912 to accommodate the described species *Cerianthus americanus*. However, this modification was performed without the specific name being suited to the agreement of correct gender. Names ending in ‘-opsis’ are feminine (ICZN – Article 30.1.2 – Examples; International Commission on Zoological Nomenclature, 1999). Thus, two specific names (*C. americanus* and *C. austroafricana*) of the genus need to be suitable for this gender concordance. Thus, the genus composition should be as listed below.

Ceriantheopsis americana (Agassiz in Verrill, 1864)

Ceriantheopsis austroafricana Molodtsova et al. 2011

Ceriantheopsis lineata sp. nov.

Ceriantheopsis nikitai Molodtsova, 2001

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