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Sea anemones of Singapore: *Synpeachia temasek* new genus, new species, and redescription of *Metapeachia tropica* (Cnidaria: Actiniaria: Haloclavidae)

Nicholas Wei Liang Yap, Daphne Gail Fautin*, Dino Angelo Ramos, and Ria Tan

(NWLY) c/o Tropical Marine Science Institute, National University of Singapore, 18 Kent Ridge Road, Singapore 119227, Republic of Singapore, e-mail: cosmogony84@gmail.com;
(DGF) Department of Ecology and Evolutionary Biology, and Biodiversity Research Center, Haworth Hall, University of Kansas, 1200 Sunnyside Drive, Lawrence, Kansas 66045, U.S.A., email: fautin@ku.edu;
(DAR) Institute of Biology, College of Science, University of the Philippines, Diliman, Quezon City 1101, Philippines, e-mail: diakom86@yahoo.com;
(RT) c/o Raffles Museum of Biodiversity Research, Department of Biological Sciences, 6 Science Drive 2, #03-01 Faculty of Science, National University of Singapore, Singapore 117546, Republic of Singapore, e-mail: hello@wildsingapore.com

Abstract.—The sea anemone *Metapeachia tropica* (Panikkar, 1938), which was described from Madras, India, and belongs in family Haloclavidae, has previously been recorded in the Republic of Singapore but without details of appearance and occurrence. We rediagnose *Metapeachia* and redescribe *M. tropica* to accommodate the specimens we studied from Singapore (35 individuals were collected and others were only observed in situ); we designate a neotype for the species. A specimen has a cream-colored column, a patterned oral disc, 16 tentacles, and a conchula. Specimens of another species of Haloclavidae occur rarely in some of the same places as *M. tropica* in Singapore; we describe it as *Synpeachia temasek* new genus, new species, based on 8 individuals we collected and others that were only observed in situ. An individual has a reddish-brown column, an oral disc that can be patterned like that of *M. tropica*, 20 tentacles, and a conchula. We infer *S. temasek* may range west at least as far as Pakistan. Specimens of both differ from the type specimens of the species described from Annam, Vietnam as *Peachia mira* Carlgren, 1943, which we have not found in Singapore. We provide a key to some members of the Haloclavidae that differentiates the new genus.

Keywords: Anthozoa, south Asia, southeast Asia, taxonomy

During inventories of the intertidal sea anemone biota of the Republic of Singapore (Fautin et al. 2009), we found two species belonging to the family Haloclavidae. Both burrow into soft sediment, their tentacles spread at the surface, the one siphonoglyph terminating in a conchula. They occur together at least on Changi Beach, along the Johor Straits, and on some southern islands (Fig. 1). The column color of these animals is consistently different; that they belong to different species is confirmed by differences in number of tentacles and macrocnemes, and in the size of nematocysts. We redescribe *Metapeachia tropica* (Panikkar, 1938), which was previously reported from Singapore, providing details of its morphology and occurrence. The other is new to science; we describe it as

* Corresponding author.

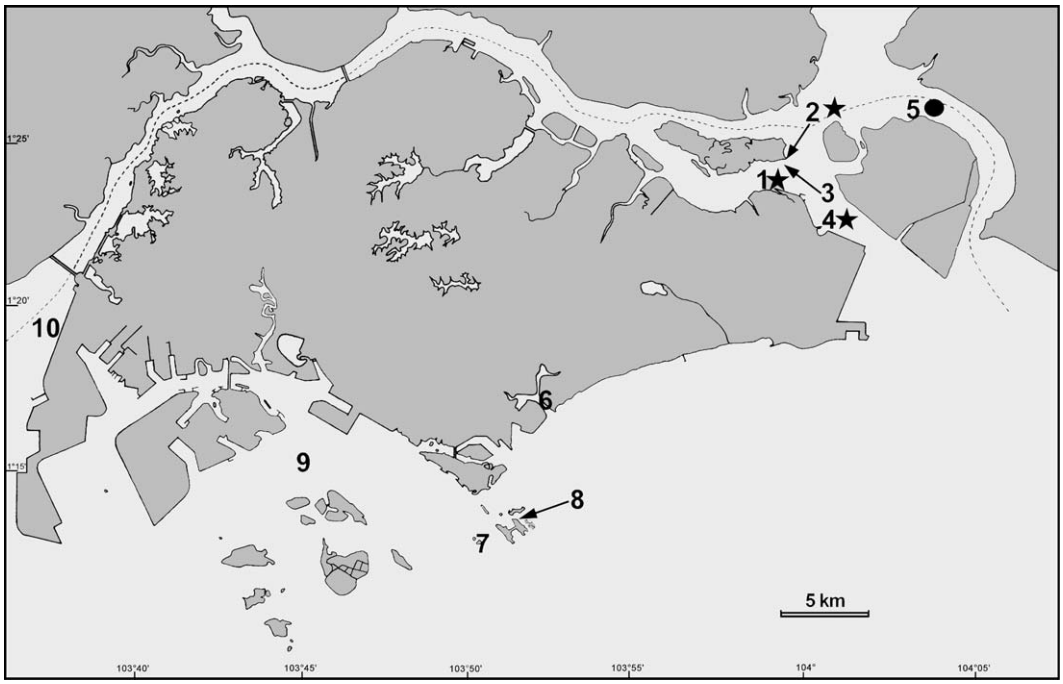

Fig. 1. Distribution of *Metapeachia tropica* and *Synpeachia temasek* in Singapore; stars indicate where individuals of both *M. tropica* and *S. temasek* were found; dot shows where only individuals of *S. temasek* were found, and only individuals of *M. tropica* were found at other numbered sites: **1.** Changi region beaches (1°23′33.34″N, 103°59′20.94″E); **2.** Chek Jawa (Pulau Ubin) (1°23′28.41″N, 103°59′28.82″E); **3.** Pulau Sekudu (1°24′19.00″N, 103°59′16.82″E); **4.** Changi Ferry Terminal beaches (1°22′26.03″N, 104°00′24.79″E); **5.** Beting Bronok (Trumbo Burong) (1°26′13.00″N, 104°02′58.00″E); **6.** Marina East (1°17′28.52″N, 103°52′03.44″E); **7.** Big Sisters' Island (Pulau Subar Laut) (1°12′50.17″N, 103°50′05.23″E); **8.** Lazarus Island (1°13′27.87″N, 103°58′00.00″E); **9.** Cyrene Reef (Terumbu Pandan) (1°15′27.50″N, 103°45′19.02″E); **10.** Tuas (1°19′33.03″N, 103°37′49.96″E).

Synpeachia temasek new genus, new species.

In his report of *M. tropica* in Singapore, England (1987:207) wrote only, "On the reef flats surrounding the Singapore islands, particularly Pulau Hantu," providing neither details of its appearance nor the rationale for his identification. The species was originally described on the basis of a single specimen from the Madras coast as *Peachia tropica* by Panikkar (1938). The only other records of it are also from the Indian subcontinent, from both the east and west coasts of India (Parulekar 1966, 1968, 1990; Goswami 1992, Mitra 2010) and from Pakistan (Haque 1977). The genus *Metapeachia* was created for the species by Carlgren (1943) because, although it has a conchula like *Peachia*, it has 16 tentacles, by contrast with *Peachia*, in which the number of tentacles is "normally 12" (Carlgren 1949:32). Other differences between *Metapeachia* and *Peachia* include the number of mesenteries (eight pairs of macrocnemes versus six pairs of macrocnemes and four pairs of microcnemes, respectively) and completeness of separation of the siphonoglyph, which terminates in a conchula, from the actinopharynx (Carlgren 1943).

The second species of Haloclavidae with a conchula we have found in Singapore has 10 pairs of mesenteries, all macrocnemes (complete, fertile, and with filaments), and 20 tentacles (although one specimen had only 19). By logical extension, because the two other genera of Haloclavidae charac-

terized by a conchula differ in number of mesenteries, it merits its own genus, which we name *Synpeachia*, new genus; we name the type species *Synpeachia temasek*, new species. Thus far it is known for certain only from Singapore.

The column of an individual of *M. tropica* is white; that of an individual of *S. temasek* is reddish-brown. We found specimens of both species on the main island of Singapore, along the south coast and at its eastern and western extremes, as well as on some southern islands. We have no information on the development of either species. We assume the larvae are parasitic on medusae, as is typical of members of the genus *Peachia* (e.g., Carlgren 1949) and was inferred for *M. tropica* on the Madras coast by Panikkar (1938).

Materials and Methods

Specimens from Singapore on which we report here were observed in situ. We collected some animals that were observed live in the laboratory and then preserved in ethanol or 10% formalin. Some animals were photographed in the field and/or laboratory. Internal morphology was studied in dissected specimens. Histological cross and longitudinal sections 8 μm thick, prepared in the standard manner and stained with Ehrlich's hematoxylin and eosin (Humason 1967), were made from some specimens.

Undischarged cnidae were measured at 1000x from tissues of tentacles, actinopharynx, column, and mesenterial filaments of some specimens. Identification of cnida types was confirmed in discharged capsules from live specimens. Taxonomy of cnidae follows Mariscal (1974).

Specimens are deposited in the Zoological Reference Collection, Raffles Museum of Biodiversity and Research, National University of Singapore (ZRC) and the Department of Invertebrate Zoology, National Museum of Natural History (Smithsonian Institution), Washington, D.C. (USNM). We examined the two syntypes of *Peachia mira* from the Swedish Museum of Natural History, Stockholm (SMNH). We also studied specimens identified as *Metapeachia* from India that are held in the collections of the USNM; from one of those lots we selected a specimen to serve as neotype of *Peachia tropica*.

Results and Taxonomic Remarks

Family Haloclavidae Verrill, 1899

Revised diagnosis of *Metapeachia* Carlgren, 1943, based on diagnosis of Carlgren (1949), with substantive changes based on our research in **bold face** and additions *italic* (minor changes of word order, etc. not indicated).

Haloclavidae with elongate body not distinctly divisible into regions; aboral end physa-like. Column **sticky**. No *marginal* sphincter muscle. Tentacles 16 (8 *arising from endocoels*, 8 *from exocoels*), **all similar length or not**. *A single deep* siphonoglyph completely separated from the actinopharynx, in its distalmost end drawn out in a *five-lobed* conchula. Pairs of mesenteries eight (six primaries and two secondaries in the lateral exocoels), all macrocnemes (complete, fertile, and *with mesenterial filaments*). *Marginal stomata present*. Retractor muscles **diffuse and strong**, parietal muscles **well developed**, similar to those in *Peachia*. Cnidom: spirocysts, basitrichs, **microbasic *b*-mastigophores,** microbasic *p*-mastigophores, **microbasic amastigophores**.

Gender.—Feminine.

Type species.—*Peachia tropica* Panikkar, 1938, by monotypy.

Discussion.—Carlgren (1949:31) stated the column has "minute suckers" but no illustration of them exists; we change the diagnosis so as not to specify the source of the stickiness. Panikkar (1938) found the inner tentacles of what he termed *Peachia tropica* to be shorter than the outer.

Carlgren (1949) made this length difference part of the generic diagnosis, but we found the tentacles in some specimens of *M. tropica* from Singapore all to be of equal length; we modify the diagnosis to allow for this variation. We found microbasic *b*-mastigophores and microbasic amastigophores, types of cnidae that have not been reported in *Metapeachia*. It can be difficult to distinguish microbasic amastigophores from microbasic *p*-mastigophores in preserved material, so they may have been seen but not recognized; microbasic *b*-mastigophores may be mistaken for basitrichs. Currently, *M. tropica* is the sole member of this genus, but Zamponi et al. (1998) mentioned an unidentified species of *Metapeachia* in the intertidal zone of southeastern Brazil. Two specimens (USNM 51675) from India that are labeled *M. tropica* are not, based on appearance and nematocyst sizes; thus, an additional species of the genus appears to occur in India. Those USNM specimens were collected from Back-bay, Bombay, by V. B. Tembe in 1958, and identified by C. E. Cutress. They agree with *Metapeachia* in having 16 tentacles and a conchula, but the smooth brownish column tapers to a point, and the animals are much shorter (250 mm and 80 mm) and narrower (oral disc diameter of both 5 mm) than those we identify as *M. tropica*.

Metapeachia tropica (Panikkar, 1938)
Figs. 2–4

Peachia sp. Menon, 1927:35.

Peachia tropica Panikkar, 1938:182–193, 200–201 (original description).

Metapeachia tropica: Carlgren, 1943:22, 1949:31.—Parulekar, 1966:40, 1968:141, 143.—Haque, 1977:35, 38.—Grebelny, 1982:107.—England, 1987:207 [Panikkar publication dated 1939].—Parulekar, 1990:220, 223, 224.—Goswami, 1992:118.—Mitra, 2010:136.

Occurrence in Singapore and material examined (Fig. 1).—Changi region beaches (ZRC.CNI.0036 x1; ZRC.CNI.0037 x1; ZRC.CNI.0293 x2; ZRC.CNI.0294 x3; ZRC.CNI.0295 x2; ZRC.CNI.0576 x1; ZRC.CNI.0577 x1; ZRC.CNI.1004 x1), Changi Ferry Terminal beaches (ZRC.CNI.0039 x1), Chek Jawa (ZRC.CNI.0718 x1), Pulau Sekudu (ZRC.CNI.0277 x1; ZRC.CNI.0400 x1), Marina East (ZRC.CNI.0362 x1), Big Sisters' Island (ZRC.CNI.0038 x4; ZRC.CNI.0571 x1; ZRC.CNI.0572 x2; ZRC.CNI.0573 x1; ZRC.CNI.0574 x2; ZRC.CNI.0575 x2; ZRC.CNI.0984 x3), Cyrene Reef (ZRC.CNI.0963 x1), Tuas (ZRC.CNI.0717 x1; ZRC.CNI.0718 x1), Lazarus Island (photographed but not collected).

Material examined from elsewhere.—India, Bombay, Cuffe Parade (USNM 1213073 x4; USNM 1213074 x1).

Live appearance and size.—Animal burrows in soft sediment, so only grey or tan patterned oral disc and 16 (rare individuals with 15) bluntly pointed tentacles 10–20 mm long visible at surface. Tentacles simple, may be somewhat longer than oral disc diameter, in two indistinct whorls near margin; four to five tentacles near conchula may be shorter than others; light colored, most with dark cross-bands (typically wavy and straight, and commonly 5–7 in number) or V- or W-shaped marks of light and dark along length on oral surface (Fig. 2A); one animal with three white tentacles (those flanking the conchula and that opposite the conchula). Mesenterial insertions visible as dark or light radial lines; some or all of area between two may be pigmented, solidly or with lines like on tentacles. Endocoel opposite conchula white in some individuals. Five-lobed conchula in center of oral opening commonly visible if actinopharynx not protruded; conchula, which may extend well out of mouth, white, with purple or brown dot at end of each lobe in some individuals (Fig. 2A). Area around mouth may be brown. When tentacles retracted and dome of distal end protrudes from sediment, 16 opaque white tapered areas visible mark-

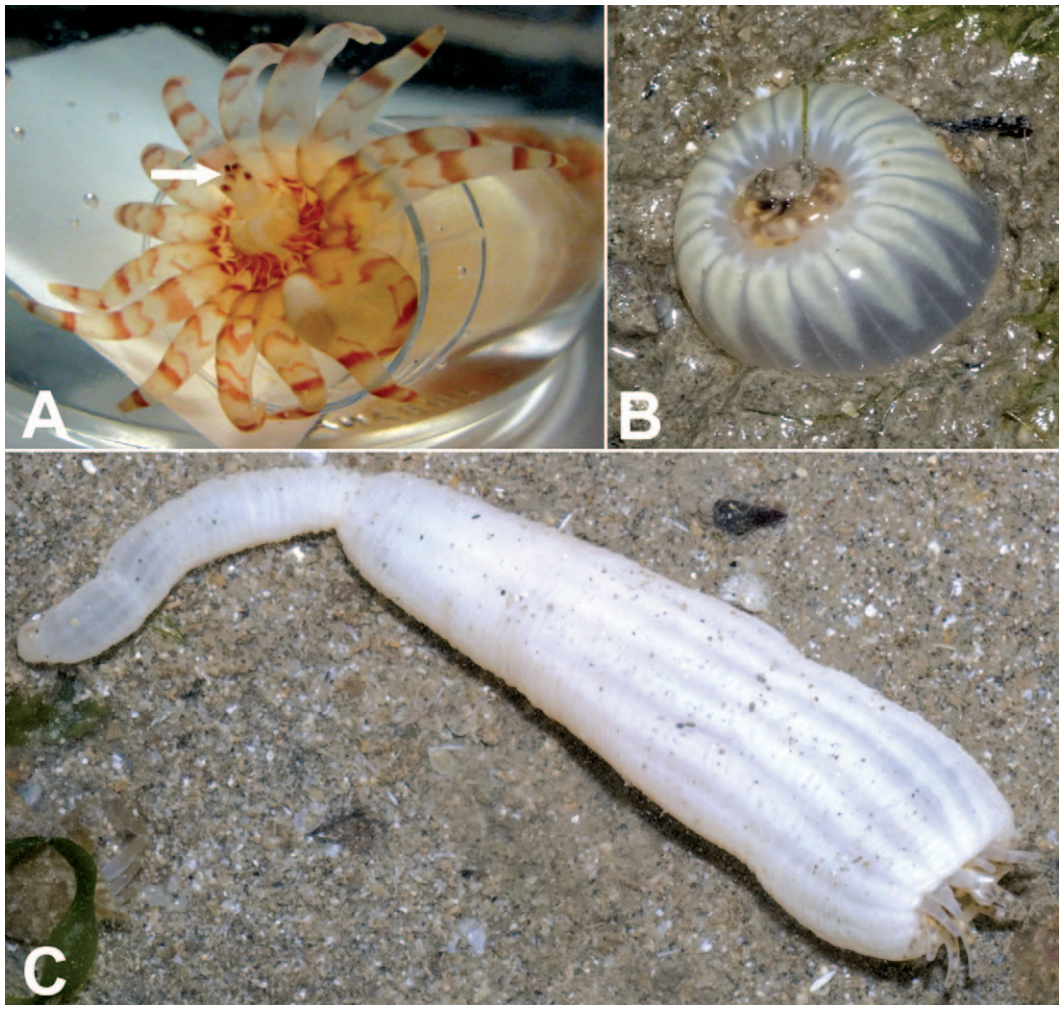

Fig. 2. Living specimens of *Metapeachia tropica*, external morphology. A, expanded oral end, showing 16 tentacles and five-lobed conchula protruding well out of mouth (white arrow); note dot at end of each lobe. Photograph by Nicholas Wei Liang Yap. B, contracted oral end in situ; 16 opaque white tapered areas mark intermesenterial spaces. Photograph by Ria Tan. C, specimen freshly removed from sediment; note unmarked wormy column and dark longitudinal lines marking mesenterial insertions. Photograph by Ria Tan.

ing intermesenterial spaces (Fig. 2B), one corresponding to each tentacle.

Pedal end blunt, physa-like; thin so mesenterial insertions visible through it as light lines. Column cream to pink or light tan color, without markings; mesenterial insertions may be visible through it as light lines (Fig. 2B) or dark ones (Fig. 2C), broadens distally. Not smooth but without obvious structures; sticky, so adheres to container in discrete spots, and when gently lifted, tissue stretches until detaches from substratum; in nature has small amounts of debris stuck to it, which may be due to viscid mucus produced at distal end.

Small or extremely retracted animals may be barrel-shaped, but most wormy (Fig. 2C); out of sediment, column can kink, and proximal end may contract in diameter so it resembles a tail (Fig. 2C). Difficult to determine size in life: column

Fig. 3. Preserved specimen of *Metapeachia tropica* (ZRC.CNI.0710). Photograph by Nicholas Wei Liang Yap.

diameter probably 10–20 mm, length may exceed 400 mm, oral disc may exceed 20 mm diameter. Contracted specimen to 200 mm long (as short as 30 mm), column diameter typically 10 mm, rather uniform throughout, although pedal end typically narrower (5 mm in large specimen) and oral end wider (15 mm). Sausage-like column easily ruptured when animal is handled.

Preserved appearance.—Tentacles shorter and blunter than in life; some crossbands may remain visible. Entire column whitish to cream-colored (Fig. 3); mesenterial insertions may be visible as longitudinal white lines. Conchula protruding, white, without markings. Column length 25 mm to 160 mm, diameter 10–15 mm. As in life, column diameter may be uniform throughout, or narrow in places, especially at proximal end; typically circumferentially wrinkled, which is evidence of shortening.

Internal anatomy.—Actinopharynx smooth, short; siphonoglyph forms a separate tube (Fig. 4A), extends proximally beyond mid-column. Eight pairs of

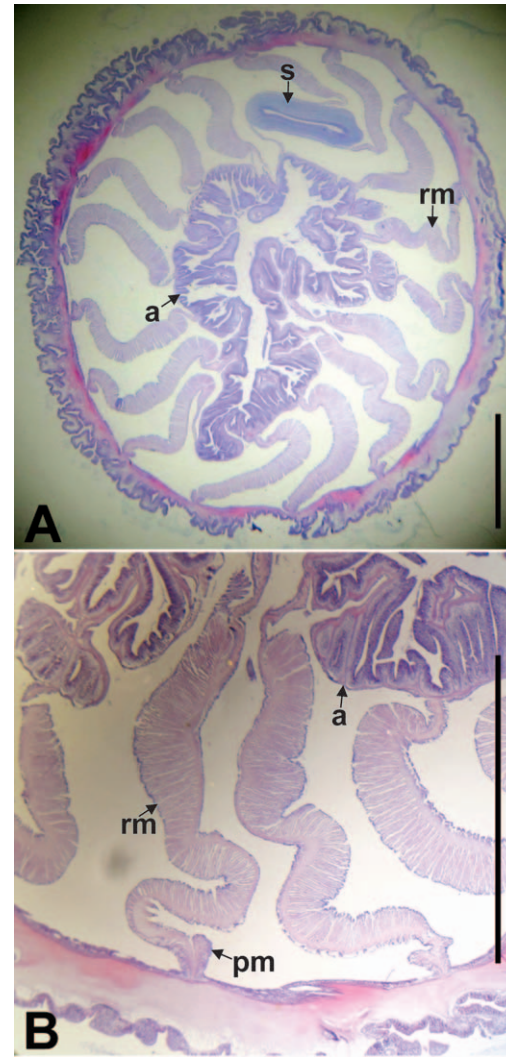

Fig. 4. *Metapeachia tropica*, internal morphology. A, cross-section at level of actinopharynx, showing eight pairs of macrocnemes, including two pairs of directives, one of which is attached to single siphonoglyph that is entirely separated from rest of actinopharynx. B, well-developed retractor muscles in cross-section; note also parietal muscle. Abbreviations: a, actinopharynx; pm, parietal muscle; rm, retractor muscle; s, siphonoglyph. Scale bars = 30 μm.

Table 1.—Cnidae of *Metapeachia tropica* (Panikkar, 1938) and *Synpeachia temasek*. Measurements in µm, values in parentheses being of single capsules that fell outside that range. *n* = number of capsules measured; N = ratio of the number of specimens having that type of cnidae to the total number of specimens examined. Not all tissues of an individual were examined. Letters following cnidae type refer to images of the cnidae in Fig. 5.

		Metapeachia tropica			*Synpeachia temasek*		
Tissue examined	Cnidae type	*n*	N	Range length × range width	*n*	N	Range length × range width
Tentacle	Spirocysts (A)	117	8/8	12.2–40.4 × 2.0–4.6	97	7/7	10.1–41.9 (46.0) × 2.0–4.0
	Basitrichs (B)	101	8/8	11.2–26.0 × 2.0–4.0	85	7/7	13.1–30.6 (33.7) × 2.0–3.5
Column	Basitrichs (C)	0	0/7	–	63	7/7	9.1–13.3 (15.2) × 1.5–3.5
	Basitrichs (D)	71	7/7	10.2–18.9 × 2.0–5.1	66	7/7	(16.2) 18.4–24.7 × 2.0–4.1 (4.5)
Actinopharynx	Basitrichs (E)	99	9/9	11.1–25.5 (28.6) × 2.0–5.1	70	7/7	(12.1) 14.1–25.8 × 2.0–5.1
	Microbasic *p*-mastigophores (F)	81	7/9	24.5–53.0 × (5.1) 6.1–15.3	73	7/7	(26.3) 28.3–40.4 × 7.1–12.1 (15.2)
Mesenterial filaments	Basitrichs (G)	79	9/9	10.1–23.5 × 1.8–3.6	51	7/7	(8.6) 12.1–24.2 × 2.0–3.6
	Microbasic *p*-mastigophores and microbasic amastigophores (H)	119	9/9	19.2–38.7 (41.3) × 4.5–10.7	70	7/7	(22.4) 24.2–38.4 (40.4) × 4.0–10.6
	Microbasic *b*-mastigophores (I)	39	9/9	(18.4) 20.4–35.0 × 4.0–7.5	31	7/7	(12.6) 19.9–30.6 (33.2) × 4.0–5.6

mesenteries, all macrocnemes, include two pairs of directives (Fig. 4A); one individual studied (ZRC.CNI.0963) had incomplete pair of macrocnemes halfway between two directives. Retractor muscles diffuse, strong, extend nearly entire width of mesenteries at level of actinopharynx in contracted individual; parietal muscles well developed (Fig. 4B). Mesenteries extend to proximal end; filaments of directive mesenteries shorter than others, those attached to siphonoglyph shortest of all; those on other four pairs of mesenteries extend to proximal end. All mesenteries with marginal stomata; all fertile; sexes separate.

Cnidae.—Cnidom spirocysts, basitrichs, microbasic *b*-mastigophores, microbasic *p*-mastigophores, microbasic amastigophores. For sizes and distribution, see Table 1; illustrations in Fig. 5.

Habitat.—Intertidal on shores of sand (e.g., Lazarus and Big Sisters' islands), mud (e.g., Tuas), and silt (e.g., Changi).

Natural history.—In our experience, animals expand on the surface mainly at night. When disturbed, they retract deeply into sediment (more than an arm's length in some cases). Their strong retractor muscles enable them to withdraw quickly, and their uniform diameter and ability to exude mucus makes them difficult to grasp, so they can be challenging to collect.

In vitro, an animal may exude copious mucus, and stick to the container; Menon (1927:35) observed, "the animal attaches itself to bottom of glass vessel." These features are manifest in situ by an animal having patches of sediment attached to strings of mucus and spots of the column.

Panikkar (1938) suggested *Metapeachia tropica* goes through a parasitic stage of development, having found sea anemone larvae on specimens of the hydromedusa *Aequorea pensile* that were collected in the same locality as adults of *M. tropica*. Larvae of *Peachia* are parasitic on hydromedusae (e.g., Carlgren 1949, Spaulding 1972).

Fig. 5. Cnidae of *Metapeachia tropica* and *Synpeachia temasek*. A, spirocyst. B, basitrich. C, basitrich. D, basitrich. E, basitrich. F, microbasic *p*-mastigophore. G, basitrich. H, microbasic *p*-mastigophore/amastigophore. I, microbasic *b*-mastigophore. Scale bar = 20 μm.

Comments.—The animal Panikkar (1938) described agrees closely with those we found. His description was based on a single small specimen; we are confident that the white animals we found in Singapore, all of which were larger than Panikkar's specimen, are *Metapeachia tropica*, and that animal size is responsible for differences between what was described for the species and what we found. Parietal muscles of the specimens we examined had more folds than Panikkar (1938) found, and the folds were branched.

Panikkar (1938) reported tentacle spirocysts as 9–16 × 2–4.0 μm, which are shorter (although not narrower) than what we found (Table 1). He did not distinguish among types of nematocysts, providing measurements only for "nematocysts of the tentacles" and "nematocysts of the column"; although it is impossible to be certain what he observed, we infer that those in the column were basitrichs. Tentacle nematocysts measured 10–14 × 2–3.5 μm, the upper end of which just overlaps the lower end of the range we found for basitrichs; the size range for column nematocysts overlaps what we found (Table 1). Parulekar (1966) stated neither the size nor the number of individuals from which he obtained cnidae but for the categories that both he and we measured (Table 1), overlap is excellent. We confirmed with discharged capsules of live specimens that both microbasic *p*-mastigophores and microbasic amastigophores occur in *M. tropica*, and that their sizes overlap. Therefore, in Table 1 we group the two into a single category.

Like us, Panikkar (1938) failed to find a clear structural cause of the animal's stickiness, rejecting the suggestion it is due to suckers made by Menon (1927) and Haque (1977), neither of whom provided illustrations of these alleged structures. Panikkar (1938) reported markings on the oral disc only at the base of each tentacle. Specimens we examined varied in

this feature (Fig. 2A), the oral disc of some animals entirely marked in a pattern similar to that on the tentacles, whereas others had marks only in patches. Some specimens resembled what Stephenson (1935) described for *Peachia hastata*. Panikkar (1938:185) described the sixteen tentacles of his specimen as "apparently disposed in two cycles, but are really formed of three cycles," with those of the inner whorl smaller. Likewise, tentacles of a Singapore specimen are arrayed in two whorls that are difficult to distinguish, all tentacles near the margin being similar in length, or those around the conchula shorter.

No type specimen of *Peachia tropica* is known to exist (Fautin 2013); we sought the holotype in the museums of the Bombay Natural History Society, the Zoological Survey of India (ZSI), the University of Madras, Department of Zoology, which was presumably the unit in which Panikkar worked, and the Indian Academy of Sciences, in the Proceedings of which the description was published. A representative of the ZSI wrote that specimen W3453/1 in the General Non-Chordata section (serial #146), which came from Madras University, is the holotype and sent us photos of it. Uncut, it is 16 mm long, and we were told it had been taken in a plankton net. The description contains figures of histological sections from the holotype, which was reportedly 30 mm long, and was "dredged ... from about a depth of not more than six fathoms" (Panikkar 1938:182). Therefore, the specimen in the ZSI (which had dried) is not the holotype. It may be a voucher specimen for the developmental part of Panikkar (1938); it strongly resembles Fig. 12 in that publication.

We believe "an exceptional need" (International Commission on Zoological Nomenclature 1999: Article 75) for a neotype to serve as an objective bearer of the name *Peachia tropica* is illustrated by the two specimens in lot USNM 51675 having been misidentified as this species. We select as neotype one of the five specimens originally in a single lot at the USNM collected at Cuffe Parade, Bombay, on 15 Mar 1963, and labeled *Metapeachia*. The collector is not specified, but at the time of collection, C. E. Cutress, then working for the USNM, was in Bombay, where he collected sea anemones of other species. Each has 16 tentacles; they are white and shaped like those we collected in Singapore – that is, the long column is of uniform diameter throughout, except where it is kinked or constricted, but those narrow parts are not consistently placed, or the distalmost end is much smaller in diameter. The animals range in total length from 48 to 130 mm. The specimen we selected as neotype is 90 mm long (the second longest), and bears USNM catalog number 1213074; the other four bear number USNM 1213073.

Article 75 of the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature 1999) deals with neotypes, Article 75.3 stipulating the conditions under which a neotype may be designated; fulfillment of each condition follows.

Article 75.3.1. We designate the neotype "with the express purpose of clarifying the taxonomic status ... of " *Peachia tropica*;

Article 75.3.2. This publication contains "a statement of the characters that [we] regard as differentiating [*Peachia tropica*] from other taxa";

Article 75.3.3. This publication contains "data and description sufficient to ensure recognition of the specimen designated";

Article 75.3.4. We state above our "reasons for believing the ... holotype ... to be lost or destroyed, and the steps ... taken to trace it";

Article 75.3.5. In this publication, we have presented "evidence that the neotype is consistent with what is known of the former name-bearing type from the original description";

Article 75.3.6. We assert that "the neotype came as nearly as practicable from the original type locality." The holotype specimen was "dredged off the Madras coast from about a depth of not more than six fathoms" (Panikkar 1938:182); the neotype came from India, although from the other coast, and was collected at an unspecified depth (it, like the holotype, was benthic, from its size and appearance).

Article 75.3.7. "The neotype is … the property of" the USNM, "a recognized scientific or educational institution … that maintains a research collection, with proper facilities for preserving name-bearing types, and that makes them accessible for study."

Synpeachia, new genus

Diagnosis.—Haloclavidae with elongate body, not distinctly divisible into regions but aboral end physa-like. Column sticky. No marginal sphincter muscle. Tentacles 20, all similar in length, shorter than diameter of oral disc. Single deep siphonoglyph completely separated from the actinopharynx, distally drawn out into a five-lobed conchula. Pairs of mesenteries 10, all complete, fertile, with mesenterial filaments (therefore macrocnemes). Marginal stomata absent. Retractor muscles diffuse and strong, parietal muscles well developed, similar to those of *Peachia* and *Metapeachia*. Cnidom: spirocysts, basitrichs, microbasic *b*-mastigophores, microbasic *p*-mastigophores, microbasic amastigophores.

Type species.—*Synpeachia temasek*, new species.

Gender.—Feminine.

Etymology.—The prefix "syn," meaning "with" or "similar to," is commonly attached to actiniarian generic names to indicate similarity to existing genera. Thus, the name *Synpeachia* means "similar to *Peachia*."

Discussion.—*Synpeachia* resembles *Peachia* in having 10 pairs of mesenteries. However, the mesenteries of *Synpeachia* are all macrocnemes, whereas *Peachia* has six pairs of macrocnemes and four pairs of microcnemes. *Synpeachia* has 20 tentacles (10 arising from endocoels, 10 arising from exocoels), whereas *Peachia* has 12 tentacles, and *Metapeachia* has 16 (which correspond to eight pairs of macrocnemes). *Metapeachia* and *Synpeachia* are similar in having the siphonoglyph separated from the actinopharynx. *Synpeachia temasek* is the only known member of the genus.

Synpeachia temasek, new species
Figs. 6–8

Occurrence and material examined (Fig. 1).—Changi region beaches (ZRC.CNI.0082 x1; ZRC.CNI.0578 x1; ZRC.CNI.0579 x1; ZRC.CNI.0709 x1; ZRC.CNI.0710 x1), Chek Jawa (photographed but not collected), Changi Ferry Terminal beaches (ZRC.CNI.0711 x1; ZRC.CNI.1005 x1; USNM 1227860 x1), Beting Bronok (photographed but not collected).

Type material.—Holotype: ZRC.CNI.0710 (Fig. 6), collected at the beach just off Changi Carpark 4 on 2 Aug 2012 by Ria Tan. A dissected female specimen from which 10 microscope slides were made.

Paratypes: ZRC.CNI.0579, collected at Changi Point SAF Chalets on 15 Jun 2011, by the Anemone Army. A dissected female specimen from which 10 microscope slides were made. ZRC.CNI.0709, collected at Changi Point SAF Chalets on 15 Aug 2011, by Ria Tan and Nicholas Yap. A dissected female specimen from which 10 microscope slides were made. USNM 1227860 collected at Changi Ferry Terminal beaches on 24 Jun 2013 by Ria Tan.

Type locality.—Beach off Changi Carpark 4, Singapore (1°23.379′N, 103°59.876′E).

Etymology.—The name *Synpeachia temasek* honors Singapore, the city-state where anemones belonging to this genus were discovered and from which they are exclusively known. Temasek, meaning sea-

Fig. 6. Holotype of *Synpeachia temasek* (ZRC. CNI.0710). Photograph by Nicholas Wei Liang Yap.

town, is the old name of Singapore; grammatically, it is a noun in apposition.

Live appearance and size.—Animal burrows in soft sediment, so only grey or tan patterned oral disc and 20 stout, bluntly pointed tentacles 5–10 mm long visible at surface. Tentacles simple, slightly shorter than oral disc diameter, most with dark cross-bands or V- or W-shaped marks of light and dark along length on oral surface (Fig. 7A). Five-lobed conchula in center of oral opening commonly visible if actinopharynx not protruded; may extend out of mouth, cream colored, without markings (Fig. 7A). When contracted, brown distal end protrudes from substratum (Fig. 7B).

Animal wormy (Fig. 7C); out of sediment, column can kink. Pedal end a blunt physa, pink, cream, or light brown; thin so mesenterial insertions visible through it as light lines. Column reddish-brown; color due to fine spots of dark pigment over lighter background (Fig. 7B, C). Irregular white spots may be arrayed along intermesenterial spaces between mid-column and pedal end (Fig. 7C). Column sticky but without obvious structures; mesenterial insertions may be visible as light or dark lines when column extended (Fig. 7C).

Difficult to determine size in life: column diameter probably 10–20 mm, length may exceed 400 mm, oral disc may exceed 20 mm diameter. Contracted specimen to 200 mm long, column diameter typically 10 mm, rather uniform throughout, although pedal end typically narrower (5 mm in large specimen) and oral end wider (15 mm). Contracted tentacles shorter than in life and blunt; 4–5 tentacles near conchula may be shorter than others.

Preserved appearance.—Column, including physa, remains reddish-brown (in both formalin and ethanol); mesenterial insertions visible as dark brown longitudinal lines, white spots may be visible (Fig. 6). May shorten greatly: length 90–170 mm, diameter to 10–15 mm. Holotype approximately 90 mm long, 15 mm diameter, narrowing to 5 mm at pedal end. Tentacles shorter than in life, blunt; some cross-bands may remain visible. Conchula white.

Internal anatomy.—Actinopharynx smooth, short; siphonoglyph forms sepa-

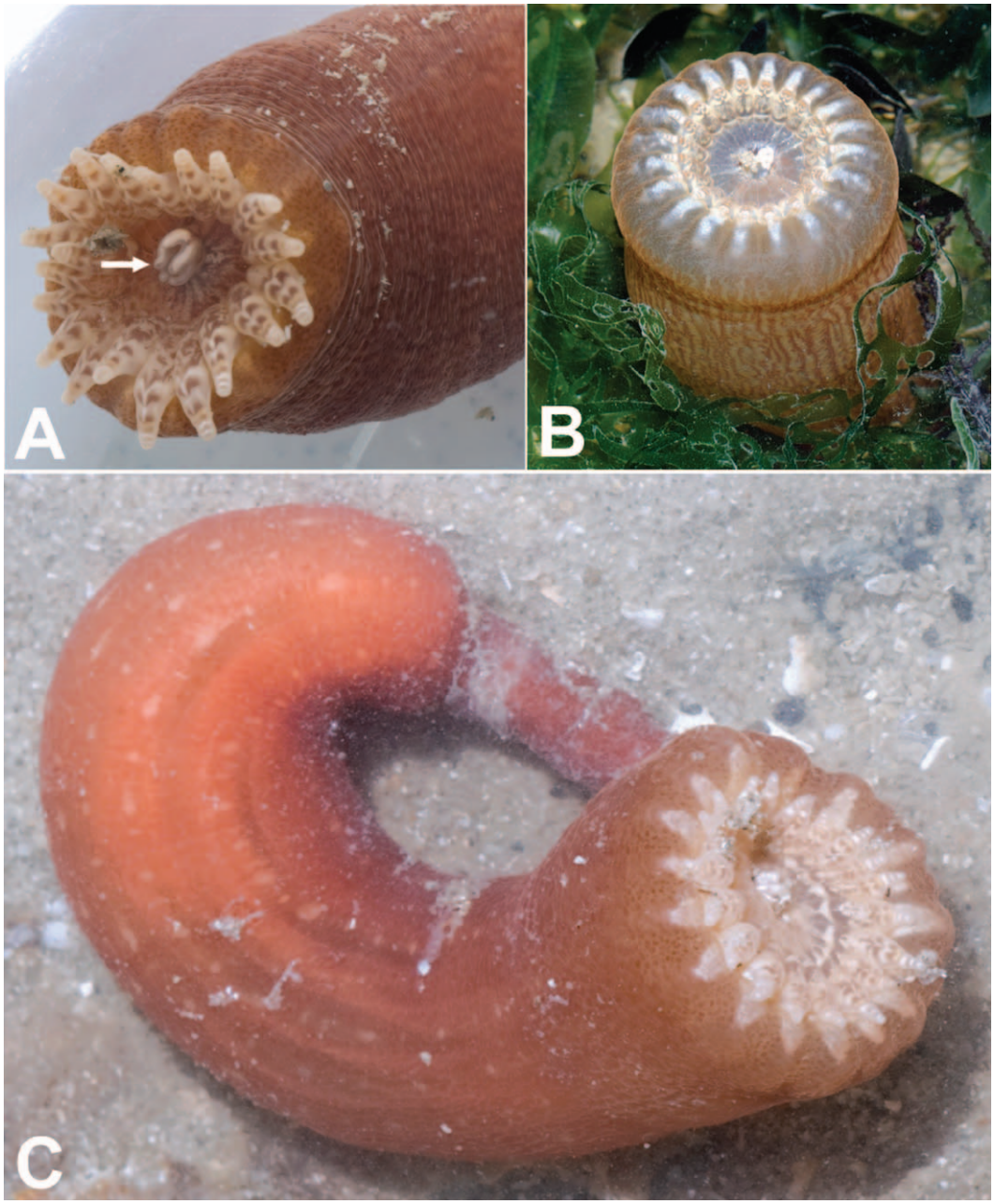

Fig. 7. *Synpeachia temasek*, external morphology. A, oral end, showing 20 bluntly pointed tentacles and unmarked conchula (white arrow) protruding from mouth. Photograph by Ria Tan. B, contracted oral end in situ, extending through algal cover; 20 opaque white tapered areas mark intermesenterial spaces. Photograph by Loh Kok Sheng, with permission. C, reddish-brown wormy specimen freshly removed from sediment; note white spots along intermesenterial spaces from mid-column to pedal end. Photograph by Ria Tan.

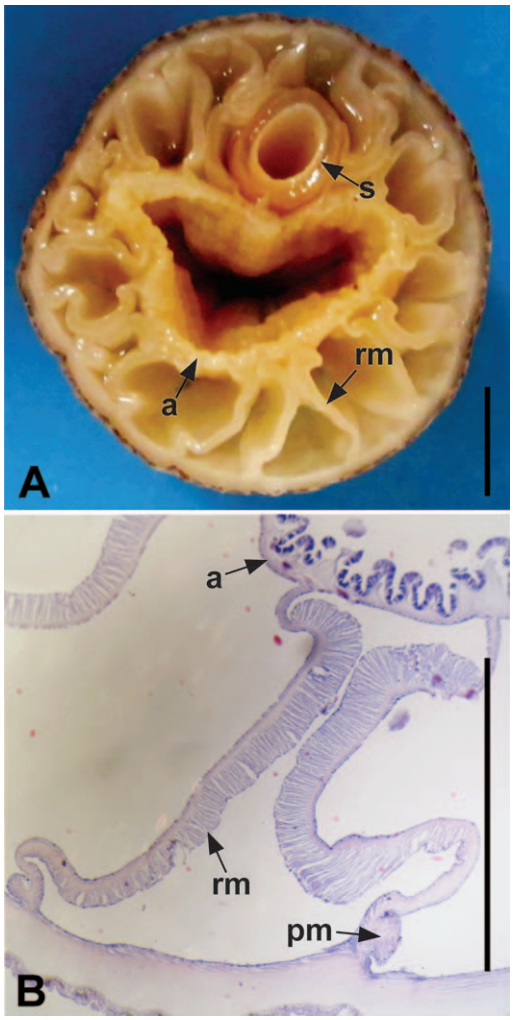

Fig. 8. *Synpeachia temasek*, internal morphology. A, cross-section at level of actinopharynx, showing 10 pairs of macrocnemes, including two pairs of directives, one of which is attached to single siphonoglyph that is entirely separated from rest of actinopharynx. B, pair of well-developed retractor muscles in cross-section; note also parietal muscle. Abbreviations: a, actinopharynx; pm, parietal muscle; rm, retractor muscle; s, siphonoglyph. Scale bars = 40 mm.

rate tube (Fig. 8A), extends proximally beyond mid-column. Ten pairs of mesenteries (Fig. 8A), all except directives extend to proximal end. All mesenteries fertile; sexes separate. Retractor muscles diffuse, strongly developed, extend entire width of mesenteries at level of actinopharynx (Fig. 8B); parietal muscle well developed.

Cnidae.—Cnidom spirocysts, basitrichs, microbasic *b*-mastigophores, microbasic *p*-mastigophores, microbasic amastigophores. For sizes and distribution, see Table 1; illustrations in Fig. 5. As with *Metapeachia tropica*, sizes of microbasic *p*-mastigophores and microbasic amastigophores overlap.

Habitat.—Silty sand and gravel.

Natural history.—As with *Metapeachia tropica*, when disturbed, an individual of *Synpeachia temasek* quickly retracts deep into sediment and may exude copious mucus. It is also sticky, and may have adherent sediment and mucus (Fig. 7A, C). In our experience, animals expand on the surface mainly at night. A possible explanation for our rarely finding specimens is that the species is mainly subtidal, so we encounter only the shallowest individuals.

Differential diagnosis.—The column of the two species in Singapore differs in color, that of *Synpeachia temasek* being reddish-brown and that of *Metapeachia tropica* being creamy white to pink. Size, oral disc markings, and tentacle form and markings of *S. temasek* and *M. tropica* are similar, and both appear to be nocturnal. However, they can be distinguished in situ: in our experience, the five-rayed conchula of the former is unmarked, whereas that of the latter may have a dot at the tip of each of its five rays; the former has 20 tentacles, whereas the latter has 16 tentacles, those of *S. temasek* being shorter and stouter than those of *M. tropica*; and even when the tentacles are retracted, column color can be seen in the dome of the distal end protruding from the sediment (compare Figs. 2B, 7B). Although both may occur in silt, specimens of *M. tropica* are found in places that are sandy (e.g., Lazarus and Big Sisters' islands), muddy (e.g., Tuas), or silty (e.g., Changi), whereas those of *S. temasek* have been found only in areas of

gravel covered with silt (Changi, Beting Bronok, and Chek Jawa). Nematocysts of the two species differ (see Table 1); among several differences, *S. temasek* has basitrichs of two size categories in its column, whereas *M. tropica* has one, and the latter has larger microbasic *p*-mastigophores in the actinopharynx than the former.

Discussion.—The specimen described by Panikkar (1938) was white, and Menon (1927:35) described what he referred to as *Peachia* sp. as "colourless," but Haque (1977:38) wrote "The column [of *Peachia tropica*] is milky-white, light-yellow, or brownish." Therefore, it is possible that some individuals of *Metapeachia tropica* are brown, but, in light of the co-occurrence of the two species we have found in Singapore and the consistent difference in their column color, the brown individuals referred to by Haque (1977) may belong to *Synpeachia temasek*. He reported *M. tropica* from three localities in Pakistan, but it is impossible to know in which of these the brown ones occurred.

Finding that column color consistently differs between species that differ also in morphological details belies Stephenson's (1928:69) generalization that pattern may be a useful taxonomic feature of sea anemones, but "colour alone is erratic in its distribution among individuals, species and genera, and that for identification little reliance can be placed upon it." Although color alone may not distinguish these two species from other members of Haloclavidae, it seems that in the geographical region where both occur, color differs consistently between the two, so it can be a useful feature for distinguishing them (number of tentacles and mesenteries, and size of nematocysts also differ).

The source of the stickiness of the column of *M. tropica* and *S. temasek* is unclear. In situ, sediment attaches to the column of individuals of both species. The presence of structures is suggested in vitro by the column adhering to the surface of a container in discrete spots, so when the animal is gently lifted, its column tissue stretches until it detaches from the substratum. In nature, small amounts of debris stick to the column, but this may be due to or aided by the viscid mucus produced at an animal's distal end.

We examined the two syntypes of *Peachia mira,* described from Viet Nam by Carlgren (1943) (SMNH 4073). The column is brownish, but not the rich reddish brown of *S. temasek*. Moreover, as reported by Carlgren (1943), both specimens have six pairs of macrocnemes and four pairs of microcnemes and have 12 tentacles. The distal end of the conchula is branched more complexly than in either of the two species that occur in Singapore. Each of its five branches has multiple prolongations (although we could not distinguish as many as Carlgren reported); the specimens being preserved, we were unable to determine if there is a dot at the tip of each. In describing *Peachia mira*, Carlgren (1943) explicitly compared the species with what he termed at the time *Peachia tropica* and for which he created the new genus *Metapeachia*.

Carlgren (1949) placed seven genera in the family Haloclavidae Verrill, 1899; Fautin (2013) listed 12 genera in it. Some families of Actiniaria are not monophyletic (e.g., Rodríguez et al. 2007), so treating those groups as units may be unjustifiable. Therefore, the dichotomous key below is to sea anemones that have a conchula, which were placed by both Carlgren (1949) and Fautin (2013) in Haloclavidae.

1A. Mesenteries all complete (macrocnemes); siphonoglyph completely separated from the actinopharynx 2

1B. Six pairs of mesenteries complete (macrocnemes), four pairs incomplete (microcnemes); siphono-

glyph rarely completely separated from actinopharynx ..... *Peachia*
2A. Eight pairs of macrocnemes only, 16 tentacles ..... *Metapeachia*
2B. Ten pairs of macrocnemes only, 20 tentacles ..... *Synpeachia*

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