Zootaxa 2058: 53–61 (2009)
www.mapress.com/zootaxa/

Article

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

Three new species of shallow water, yellow zoanthids (Hexacorallia: Zoanthidea: Epizoanthidae) from southern California, USA, and southern Australia

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Abstract

In southern California and southern Australia, several species of hexacorals that are common at diving depths have been referred to as "Yellow Zoanthids." We describe three new species of them in the genus *Epizoanthus* because all have a macrocnemic mesenterial arrangement and mesogleal marginal sphincter muscle. *Epizoanthus giveni* is from southern California, and *Epizoanthus karenae* and *Epizoanthus rodmani* are from southern Australia. Distinguishing features of *E. giveni* **n. sp.** are a sphincter muscle with alveoli arrayed in a single, longitudinal column, polyps no longer than 8 mm beyond the coenenchyme, obvious scapus ridges numbering 19 or fewer, and mesenteries numbering 36 or fewer. Distinguishing features of *E. karenae* **n. sp.** are radiating dark-orange lines on the oral disc (in life), a broad sphincter muscle filling most of the margin distally and transversely stratified proximally, polyps no longer than 12 mm beyond the coenenchyme, obvious scapus ridges numbering 20 or fewer, and mesenteries numbering no more than 40. Distinguishing features of *E. rodmani* **n. sp.** are the lack of lines on the oral disc (in life), a sphincter muscle situated in the middle of the mesoglea with alveoli more elliptical than circular in section, polyps no longer than 8 mm beyond the coenenchyme, scapus ridges not obvious, and mesenteries numbering 48 or fewer.

Key words: Cnidaria, Coelenterata, *Epizoanthus*, Pacific Ocean, taxonomy, Zoantharia, Zoanthiniaria

Introduction

We describe three new species of shallow-water zoanthids, *Epizoanthus giveni* **n. sp.** from the north-eastern Pacific Ocean off southern California, USA, and *Epizoanthus karenae* **n. sp.** and *Epizoanthus rodmani* **n. sp.** from the south-western Pacific Ocean off southern Australia. All have been observed and photographed by scuba divers for many years, and in both places are commonly referred to as "Yellow Zoanthids" (Gotshall 2005; Gowlett-Holmes 2008).

Zoanthidea, one of the least-studied orders of phylum Cnidaria, has about 330 nominal species (Fautin 2008) among which are likely to be many synonyms (Burnett *et al.* 1997). Zoanthids, most species of which are clonal or colonial, live from shallow to deep water throughout the world's oceans, many in symbiosis with other animals such as octocorals and hermit crabs (Ryland *et al.* 2004). A zoanthid polyp has one siphonoglyph, two cycles of tentacles, and mesenteries that have been referred to as both paired and coupled (Hyman 1940; Dunn 1982; Herberts 1987; Manuel 1981) or only paired (Pax 1925; Walsh 1967; Ryland and Lancaster 2003). Individuals of most species range in diameter from 3 to 15 mm (Ryland and Lancaster 2003).

One reason for the dearth of knowledge about these animals is that zoanthids can be difficult to identify, being homogeneous morphologically when compared with members of other hexacorallian orders. Another reason for the scarcity of research on these animals is that in many species, particles (e.g. sand grains) incorporated into the mesoglea (Ryland and Muirhead 1993) cause problems in making histological sections, which are necessary to study the taxonomically important musculature and mesenterial arrangement.

Accepted by P. Alderslade: 20 Feb. 2009; published: 30 Mar. 2009

We place all three new species in the genus *Epizoanthus* (a member of family Epizoanthidae) based on the macrocnemic mesenterial arrangement and mesogleal marginal sphincter muscle. By contrast, in the macrocnemic genus *Parazoanthus* (family Parazoanthidae), the marginal sphincter muscle is located in the endoderm. Some species of these two genera are very similar in appearance; histology is necessary to place them in the correct family.

Molecular sequence data for zoanthids are beginning to accumulate (e.g. Reimer *et al.* 2006) but are available for only a small proportion of described species.

Materials and methods

We did not have access to live material; all data are from preserved specimens. Specimens of yellow zoanthids from California were collected by Adam Daw off Santa Catalina Island; when we received them they were preserved in 70% ethanol. Samples from southern Australia were collected by Karen L. Gowlett-Holmes from South Australia and Tasmania; when we received them they were preserved in 70% ethanol. We do not know the preservation history of the specimens and, based on experience, did not consider the material suitable for molecular analysis. Moreover, for the species from California, in each container we received were several pieces each consisting of multiple polyps. We were assured—and were able to ascertain—that each consisted of a single species. However, because we do not know whether the pieces had been part of one or more than one colony, we designate the material syntypes.

For each species, histological sections 8–10 μm thick were made from one large and one small polyp from each of several pieces. Large sand grains in the tissue were picked out with a probe before sectioning. Although fine sand tore parts of sections, there were sufficiently few grains that histology was possible. Cross sections were cut transversely across the column, at the level of the actinopharynx. Sections showing a cross section of the marginal sphincter muscle were cut longitudinally at the distal end of the column, in a diametric plane (that is, it passed through the center of the animal). They were stained with hematoxylin and eosin or Gomori trichrome (Humason 1967).

Undischarged nematocysts were measured from distal and proximal tentacle ends, actinopharynx, and mesenterial filaments of at least six polyps of each species at 1000x using differential interference microscopy and ScanPro measurement software (Jandel Scientific Software) with a Summa Sketch digitizing desk (Summagraphics). Cnidae identification was based on Ryland and Lancaster (2004).

Type material is deposited at the Santa Barbara Museum of Natural History, Santa Barbara, California, USA (SBMNH), the South Australian Museum, Adelaide, South Australia, Australia (SAM), the Division of Invertebrate Zoology of the University of Kansas Natural History Museum, Lawrence, Kansas, USA (KUDIZ), and the U.S. National Museum of Natural History, Washington, D.C., USA (USNM).

Descriptions

Genus *Epizoanthus* Gray, 1867

Epizoanthidae (defined by macrocnemic mesenterial arrangement and single mesogleal marginal sphincter muscle) lacking a canal system and lacunae in the mesoglea of the column; cell islets present.

Epizoanthus giveni new species

Figures 1A, 2A

Material examined. North-eastern Pacific Ocean, USA, California, Los Angeles County, Santa Catalina

Island, Two Harbors, west end of Ship Rock (33º27'N, 118º29'W), 62 ft (19 m), collected by Adam Daw, 13 December 2006; SBMNH 423117, Syntypes, 3 pieces of 23, 17, and 24 polyps each; KUDIZ 002985, Syntypes, 3 pieces of 38, 10, and 27 polyps each. Same locality and depth, collected by Adam Daw, 10 November 2006; SBMNH 423118, Syntypes, 6 pieces of 15, 14, 13, 9, 22, and 5 polyps each; USNM 1116110, Syntypes, 4 pieces of 14, 9, 11, and 18 polyps each.

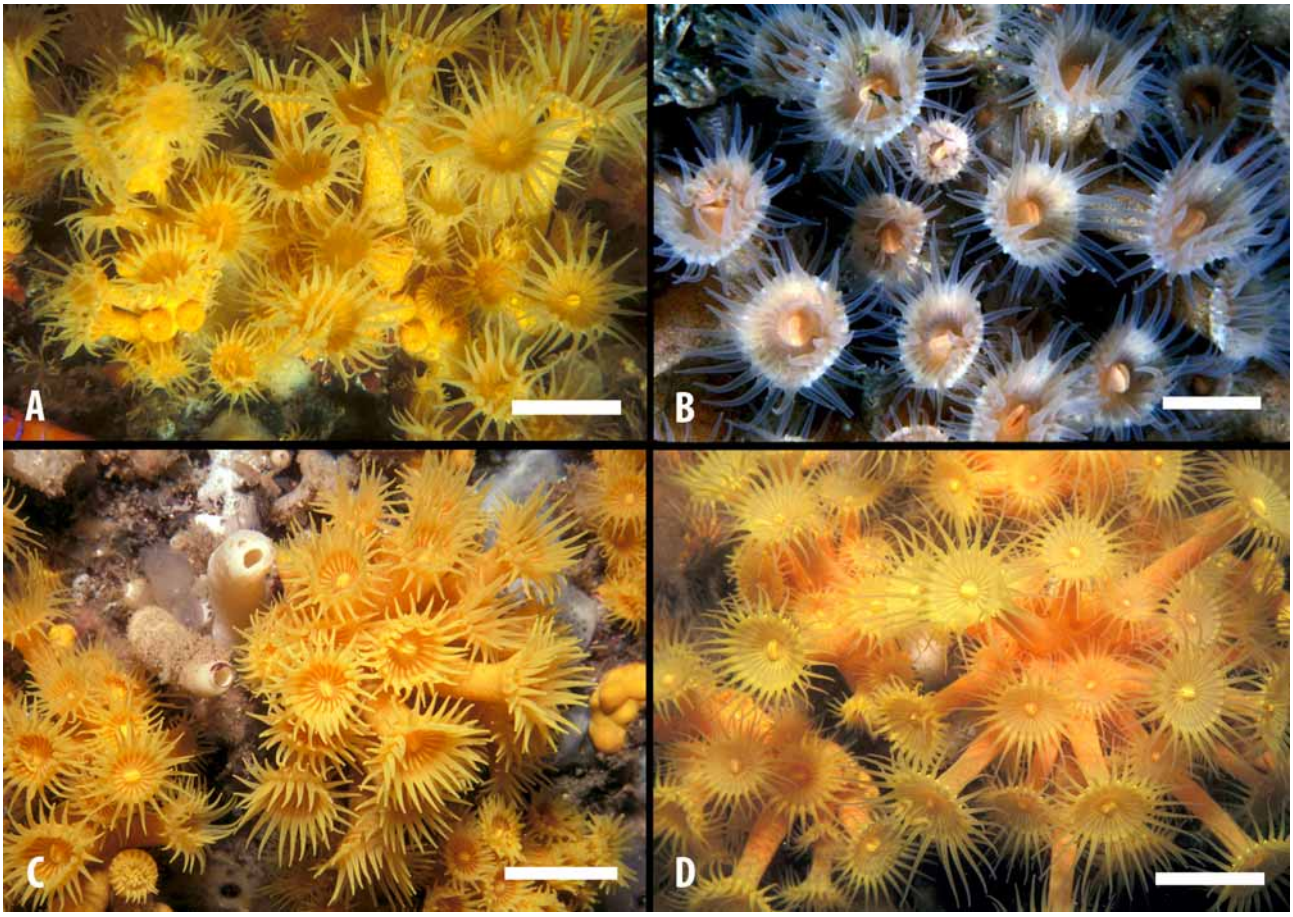

FIGURE 1. A. *Epizoanthus giveni* **n. sp.** in life, attached to a rock wall. Note vivid yellow color and polyps of various sizes. Photograph by Daniel W. Gotshall, with permission. B. *Epizoanthus scotinus* in life. Note wider oral disc and paler column, tentacles, and oral disc as compared to *E. giveni* **n. sp.** Photograph by Daniel W. Gotshall, with permission. C. *Epizoanthus karenae* **n. sp.** in life. Note radiating dark-orange lines on oral disc. Photograph by Karen Gowlett-Holmes, with permission. D. *Epizoanthus rodmani* **n. sp.** in life. Note lack of radiating lines on oral disc. Photograph by Karen Gowlett-Holmes, with permission. Scale bars = 2 cm; scale was determined in consultation with the photographers.

Colony morphology and color. In life, vivid yellow (Adam Daw, pers. comm.; Figure 1A; Gotshall 2005: fig. 70); in preservative, light-brown/tan. Polyps spaced as much as a polyp diameter apart, smaller ones interspersed among larger ones; some flush with surface of coenenchyme but most protrude.

External anatomy. In preserved specimens, contracted polyps protrude no more than 8 mm from thin (0.5–1.5 mm thick) coenenchyme; 2–5 mm diameter when contracted. Ectoderm and outer mesoglea densely encrusted with sand, contributing to the polyps' color. Scapus ridges obvious in closed polyps, increase in number with size of polyp to maximum of 19.

Internal anatomy. Marginal sphincter muscle alveolar; alveoli situated in middle of mesoglea, slightly nearer endoderm proximally and ectoderm distally; alveoli occupy no more than a quarter the width of the mesoglea, arrayed in a longitudinal column (Figure 2A). Mesenteries number 26 in smaller polyp (0.5 mm diameter) to 36 in many larger polyps (5 mm in diameter). Actinopharynx uncorrugated. Siphonoglyph apparent. No zooxanthellae.

Cnidae. Cnidom spirocysts, basitrichs, holotrichs, microbasic *b*-mastigophores, microbasic *p*-mastigophores (Figure 3). See Table 1 for sizes and distribution. Cnidae from the proximal and distal parts of tentacles did not differ, so measurements from them were combined.

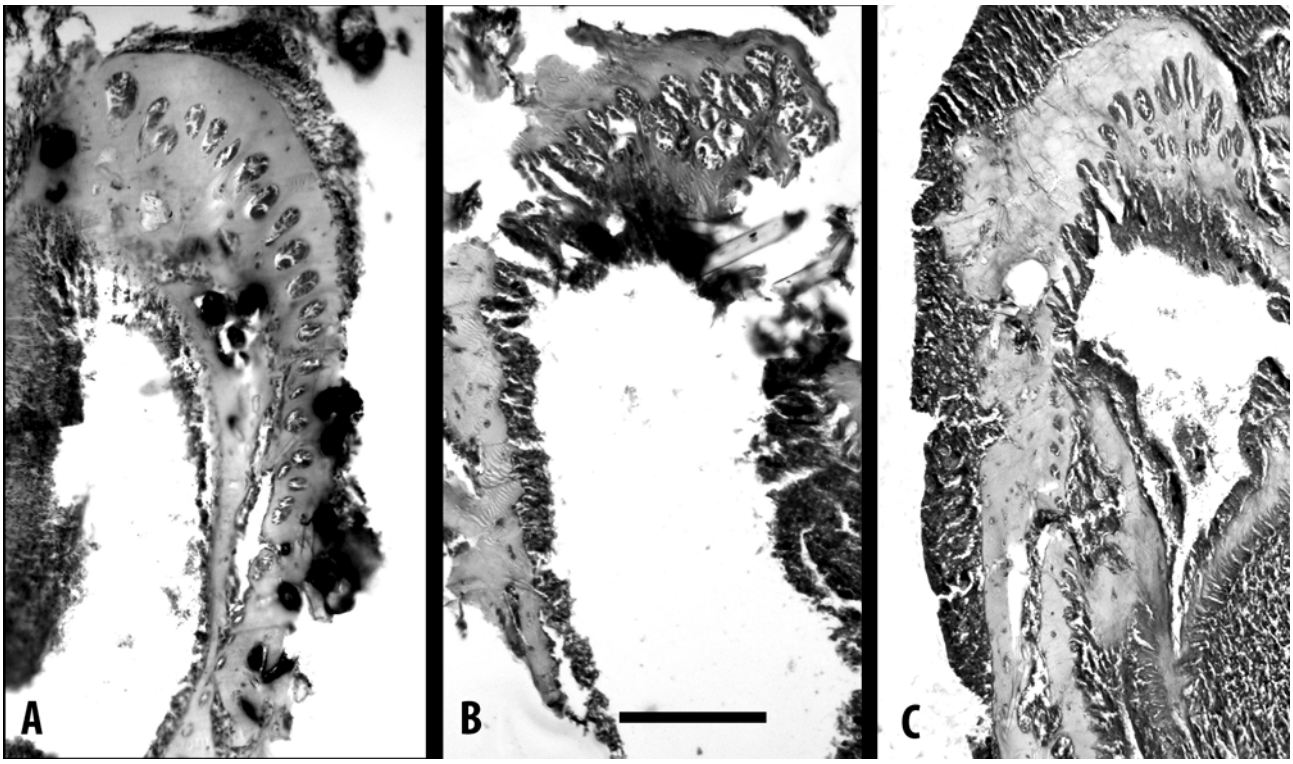

FIGURE 2. Longitudinal sections through alveolar marginal sphincter muscles of new species of *Epizoanthus*. A. *Epizoanthus giveni* **n. sp.** Alveoli nearly circular in cross section, arrayed in single column, separate from one another, decrease in diameter proximally. B. *Epizoanthus karenae* **n. sp.** Alveoli not stratified and fill most of margin distally, transversely stratified and near endoderm proximally. C. *Epizoanthus rodmani* **n. sp.** Alveoli elongate in cross section, located nearer ectoderm distally, near endoderm proximally. Scale bar = 200 µm.

TABLE 1. Cnidae of *Epizoanthus giveni* **n. sp.** N is the ratio of the number of individuals examined having a particular type of nematocyst to the total number examined; n is the number of measured capsules. Measurements, in µm, are given as a range of length x width; values in parentheses are of exceptionally large or small capsules. Letters refer to images in Figure 3.

Tissue	Type	N	n	Size
Tentacle	spirocyst (F)	6/6	128	(9.6) 11.0–21.8 (24.2) x 2.0–4.7
	basitrich (A)	6/6	92	(14.1) 16.0–26.9 (28.7) x 2.2–5.4
	microbasic *b*-mastigophore (D)	6/6	96	(13.3) 14.4–25.7 x 2.2–5.0
Actinopharynx	basitrich (A)	6/6	78	16.7–29.5 (30.8) x 2.5–5.9
	holotrich (E)	5/6	44	9.3–12.6 x 3.0–5.0
	holotrich (G)	3/6	8	28.7–42.0 x 12.3–20.4
Filament	holotrich (E)	6/6	52	(9.0) 10.3–13.6 x 2.0–4.9
	holotrich (G)	6/6	30	(23.1) 25.9–31.5 (35.3) x 10.0–15.5
	microbasic *p*-mastigophore (C)	4/6	40	15.6–22.1 x 3.3–6.2
	basitrich (A)	4/6	28	(16.6) 19.7–28.0 x 3.3–5.1

TABLE 2. Differences among some species of *Epizoanthus* and *Parazoanthus*; new species bolded. Data from original descriptions except as noted.

	Sphincter muscle location and morphology	Polyp length (mm)	Polyp diameter (mm)	Mesenteries	Scapus ridges	Color	Distribution	Other distinguishing features
***E. giveni* n. sp.**	Mesoglea: alveolar, alveoli arrayed longitudinally	8 or less	2 to 5	26 to 36	to 19, number increases with polyp size	vivid yellow (fig. 1A)	Islets off Southern Channel Islands California, USA	
E. californicum Carlgren, 1951	Mesoglea: strong with meshes drawn out transversely	9 or less	3 to 4	34 to 38	none	yellowish-brown	Gulf of California, Mexico	
E. gabrieli Carlgren, 1951	Mesoglea: strong, broad, transversely stratified	8 or less	3.5 or less	to 30	distinct	unknown	Gulf of California, Mexico	
E. induratum Cutress & Pequegnat, 1960	Mesoglea: scattered alveoli of various sizes	1 to 5	1.5 to 4	to 38	to 22	pale salmon	Corona del Mar, California	weakly bioluminescent
E. leptoderma Cutress & Pequegnat, 1960	Mesoglea: broad alveoli nearer endoderm than ectoderm	5 to 20	1.5 to 5	to 36	to 18	tan	Corona del Mar, California	
E. scotinus Wood, 1958	Mesoglea: strong, transversely stratified, fills width of mesoglea most of length, against ectoderm proximally	70 or less	10 to 30	40 to 70	unknown	reddish-brown to light yellow, mouth brighter orange (fig. 1B) (data also from Gotshall 2005)	Northern Channel Islands of California to Puget Sound, Washington (Gotshall 2005)	
***E. karenae* n. sp.**	Mesoglea: alveoli broad, unstratified and filling most of margin distally, stratified proximally	12 or less	2 to 5	36 to 40	distinct, 20, in small and large polyps	vivid yellow with radiating dark-orange lines on oral disc	South Australia and New Zealand	may occur among sponges (fig. 1C; Gowlett-Holmes 2008)
***E. rodmani* n. sp.**	Mesoglea: alveoli elongate, situated in middle of mesoglea	8 or less	3 to 4.5	42 to 48	none obvious	vivid yellow	Southern Australia	
E. sabulosum Cutress, 1971	Mesoglea: alveoli few, scattered, in center of mesoglea distally, nearer ectoderm proximally	4 or less	3 or less	to 30	to 15	unknown	Southern Australia	epizoic with sponges; contains zooxanthellae
P. axinellae (Schmidt, 1862) (data from Herberts 1972, Manuel 1981)	Endoderm: diffuse and long	2 to 15	2 to 5	28 - 39	14 to 18	pale yellow to orange; deeper color around mouth	Mediterranean, northeastern Atlantic	epizoic with sponges and other animals such as gogonians, worm tubes, and shells
P. elongatus McMurrich, 1904	Endoderm: very weak, almost unbranched, with scattered mesogleal processes	15 to 20	3 to 4	28 to 32	to 15	unknown	Calbuco, Chile	epizoic with hydroids

Natural history, geography. The specimens of *Epizoanthus giveni* **n. sp.** we studied had been attached to a rock wall at 19 m. At present this species is known only from small islets off the southern Channel Islands of Santa Catalina and San Clemente.

Etymology. *Epizoanthus giveni* **n. sp.** is named in honor of Dr. Robert R. Given, who worked at the University of Southern California Wrigley Marine Science Center, and played a major role in establishing the Catalina Island Conservancy, which has served to preserve the natural environment of the island for more than

40 years. Dr. Given, like many other biologists and collectors, pointed out the need for this species to be named.

Differential diagnosis. See Table 2, which compares features of all three new species with those of some sympatric and externally similar species. Additionally, in the Channel Islands of California, ***E****pizoanthus giveni* **n. sp.** occurs in the same habitat as two other species of *Epizoanthus*, *E. leptoderma* Cutress and Pequegnat, 1960, and *E. induratum* Cutress and Pequegnat, 1960. *Epizoanthus induratum* occurs at greater depths than *E. giveni* **n. sp.** and is weakly bioluminescent (Cutress & Pequegnat 1960). Three species of zoanthids are illustrated in the field guide by Gotshall (2005: 34): two are referred to as "Yellow Zoanthids"—*Parazoanthus lucificum* Cutress and Pequegnat, 1960, which is attached to gorgonians, and *E. scotinus*, depicted in our Fig. 1B—and *E. giveni* **n. sp.**, which is labeled "ZOANTHID (*undescribed species*)."

In comparison to *E. giveni* **n. sp.**, *E. leptoderma* contains smaller spirocysts and microbasic *b*-mastigophores of the tentacles, and also has microbasic *b*-mastigophores in the actinopharynx; *E. induratum* contains holotrichs in the tentacles and microbasic *b*-mastigophores in the actinopharynx; *E. scotinus* has holotrichs in the tentacles, much larger spirocysts, microbasic *p*-mastigophores in the actinopharynx, and atrichous isorhizas in the ectoderm. Atrichous isorhizas are not known in zoanthids at the small sizes reported by Wood (1957) (Ryland & Lancaster 2004). It is possible that the capsules measured were small holotrichs, which were once referred to as atrichous isorhizas (Cutress 1955). According to Bigger (1982), the two are difficult to distinguish with a light microscope and the nematocysts should be considered holotrichs. Two other similar species are *E. californicum* Carlgren, 1951, and *E. gabrieli* Carlgren, 1951. In comparison to *E. giveni* **n. sp.** *E. californicum* has holotrichs in the tentacles and microbasic *b*-mastigophores in the actinopharynx; *E. gabrieli* has smaller microbasic *b*-mastigophores in the tentacles and only holotrichs of the small variety were measured.

Epizoanthus karenae **new species**
Figures 1C, 2B

Material examined. Pacific Ocean, Australia, South Australia, Gambier Group, Wedge Island, NE point, ~35° 09'S, 136° 28'E, 8–10 m, collected by K.L. Gowlett-Holmes, 20 March 2001; SAM H1602, Holotype, 24 polyps. Pacific Ocean, Australia, Tasmania, Tasman Peninsula, off O'Hara Bay, ~43° 05'S, 147° 48'E, 15–20 m, collected by K.L. Gowlett-Holmes and G. Myers, 31 July 1991; KUDIZ 002983, Paratype, 15 polyps.

Colony morphology and color. In life, vivid yellow with dark-orange lines radiating on oral disc (Figure 1C; Gowlett-Holmes 2008: p. 49, photo of "Undescribed species"). In preservative, dark-yellow/brown. Polyps close together, smaller ones surrounding larger ones. All protrude from surface of coenenchyme.

External anatomy. In preserved specimens, contracted polyps protrude no more than 12 mm from thin (1–2 mm thick) coenenchyme; 2–5 mm in diameter when contracted. Ectoderm and outer mesoglea densely encrusted with dark sand and quartz, contributing to brownish color. Scapus ridges obvious in closed polyps, number to 20 in small and large polyps.

Internal anatomy. Marginal sphincter muscle broad, alveoli not stratified and fill most of margin distally, transversely stratified and near endoderm proximally (Figure 2B). Mesenteries number to 36 in smaller polyp (2.5 mm diameter) to 40 in many larger polyps (5 mm diameter). Macrocnemes (20 in polyps with 40 mesenteries) equal number of scapus ridges. Actinopharynx longitudinally corrugated. Siphonoglyph apparent. No zooxanthellae.

Cnidae. Cnidom spirocysts, basitrichs, holotrichs, microbasic *b*-mastigophores, microbasic *p*-mastigophores (Figure 3). See Table 3 for sizes and distribution.

Natural history, geography. Specimens studied were collected from a rock wall at 8–20 m. Also known from New Zealand (Gowlett-Holmes 2008).

Etymology. *Epizoanthus karenae* **n. sp.** is named after Karen L. Gowlett-Holmes in honor of her many contributions to knowledge of the Australian fauna, and the wonderful photographs she has taken of so many animals.

TABLE 3. Cnidae of *Epizoanthus karenae* **n. sp** and *Epizoanthus rodmani* **n. sp**. N is the ratio of the number of individuals examined having a particular type of nematocyst to the total number examined; n is the number of measured capsules. Measurements, in µm, are given as a range of length x width; values in parentheses are of exceptionally large or small capsules. Letters refer to images in Figure 3.

		E. karenae			*E. rodmani*		
Tissue	Type	N	n	Size	N	n	Size
Tentacle: distal part	spirocyst (F)	6/6	63	(13.3) 14.1–22.6 (23.8) x 2.3–4.3	6/6	64	12.6–22.6 x 2.3–4.3
	basitrich (B)	6/6	51	16.4–28.5 x 2.3–5.7	3/6	23	15.7–19.3 (21.0) x 2.5–4.4
	microbasic *b*-mastigophore (D)	6/6	64	(16.7) 17.8–28.6 (32.6) x 3.1–5.5	3/6	32	18.0–25.9 x 3.8–5.7
Tentacle: proximal part	spirocyst (F)	6/6	60	14.5–23.3 x 2.0–4.3 (5.6)	6/6	63	13.2–22.7 x 2.2–4.0
	basitrich (B)	4/6	37	16.7–22.2 (24.4) x 2.1–3.8	4/6	41	(16.4) 17.7–22.1 (23.4) x 2.4–3.8
	microbasic *b*-mastigophore (D)	6/6	60	16.5–30.4 x 3.0–5.2 (5.6)	5/6	45	(14.5) 16.9–23.6 x 3.3–5.6
Actinopharynx	basitrich (B)	6/6	61	17.9–26.5 x 3.0–5.8	6/6	72	16.9–26.2 x 3.6–5.4
	holotrich (G)	5/6	39	18.7–29.1 x 8.2–13.3	5/6	37	20.3–28.9 (30.4) x 9.8–18.5
	holotrich (E)	4/6	36	9.0–13.3 x 3.0–5.5	5/6	52	(5.4) 7.0–12.7 x 2.8–4.3
	microbasic *p*-mastigophore (C)	3/6	23	18.0–23.5 x 3.4–6.8	1/6	7	18.6–20.7 x 4.6–6.0 (8.1)
Filament	holotrich (E)	6/6	57	8.9–14.5 x 3.1–5.8	6/6	60	8.0–13.6 (15.0) x 2.5–5.1
	holotrich (G)	6/6	48	22.1–32.8 (36.0) x 9.7–16.2 (18.4)	6/6	44	19.3–31.3 x 10.0–16.2
	microbasic *b*-mastigophore (D)	3/6	28	15.4–20.6 (23.0) x 3.6–5.3	3/6	21	15.7–21.2 (25.6) x 3.6–5.9
	microbasic *p*-mastigophore (C)	6/6	64	17.1–23.2 (25.1) x 3.6–6.5	6/6	59	(16.3) 18.1–22.2 (24.1) x 4.0–6.1

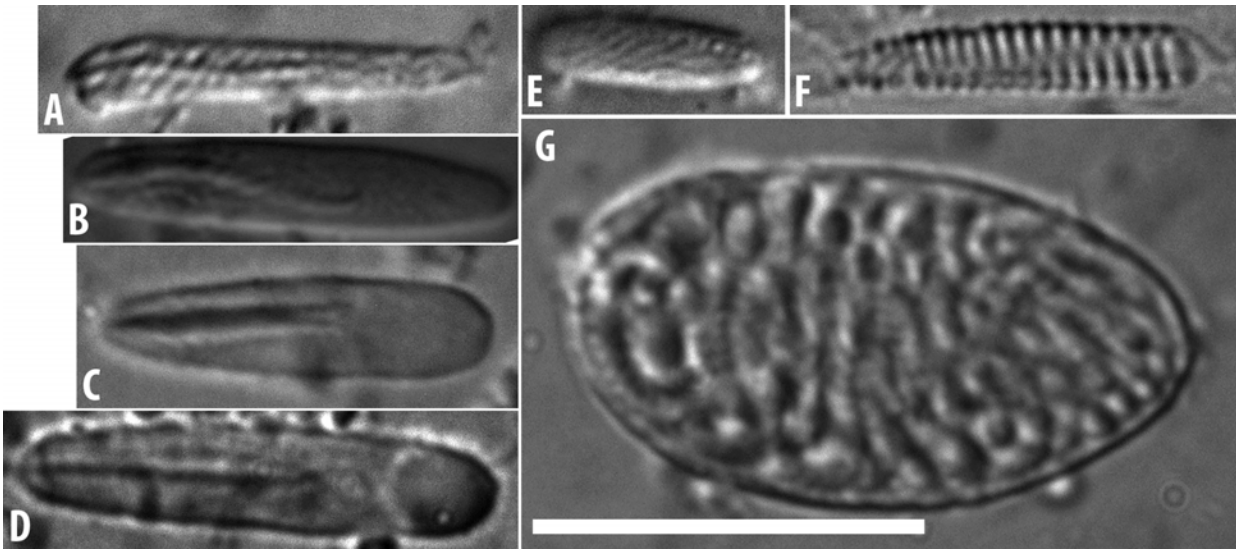

FIGURE 3. Cnidae. Scale bar = 20 µm; refer to Tables 1 and 3 for occurrences and size ranges. A. Basitrich. B. Basitrich. C. Microbasic *p*-mastigophore. D. Microbasic *b*-mastigophore. E. Holotrich. F. Spirocyst. G. Holotrich.

***Epizoanthus rodmani* new species**
Figures 1D, 2C

Material examined. Pacific Ocean, Australia, Tasmania, Port Davey, Bathurst Channel, off Joan Point, ~43° 20'S, 146° 04'E, 5–21 m, collected by K.L. Gowlett-Holmes, 5 April 1993; SAM H1603, Holotype, 22 polyps. Pacific Ocean, Australia, South Australia, Kangaroo Island, W of Western River Cove, Pissy Boy Rock, "The Amphitheater", ~35° 40'S, 136°58'E, 7–9 m, collected by K.L. Gowlett-Holmes, 9 March 2002; KUDIZ 002984, Paratypes, 2 pieces (unknown whether from a single colony) of 6 and 18 polyps.

Colony morphology and color. In life, vivid yellow (Figure 1D) (Karen L. Gowlett-Holmes, CSIRO, Hobart, pers. comm.). In preservative, yellow/light brown. Three pieces examined had 7–22 polyps each. In preserved material, coenenchyme surface visible between polyps, smaller polyps interspersed among larger ones; all protrude from surface of coenenchyme.

External anatomy. In preserved specimens, contracted polyps protrude no more than 8 mm from thin (1 mm thick) coenenchyme; 3–4.5 mm in diameter when contracted. Ectoderm densely encrusted with dark sand and quartz contributing to polyps' dark color. Scapus ridges not obvious in closed polyps.

Internal anatomy. Marginal sphincter muscle alveolar, situated in middle of mesoglea, nearer ectoderm distally, nearer endoderm proximally (Figure 2C), alveoli elongate, more elliptical than circular in section. Mesenteries 42 in polyp 3 mm in diameter to 48 in polyp 4.5 mm in diameter. Actinopharynx longitudinally corrugated. Siphonoglyph apparent. No zooxanthellae.

Cnidae. Cnidom spirocysts, basitrichs, holotrichs, microbasic *b*-mastigophores, microbasic *p*-mastigophores (Figure 3). See Table 3 for sizes and distribution.

Natural history, geography. Specimens studied were collected from a rock wall at 5–21 m.

Etymology. *Epizoanthus rodmani* **n. sp.** is named in honor of Dr. James E. Rodman, who helped taxonomy in all fields as Director in the Division of Environmental Biology of the US National Science Foundation and especially by creating and supporting the program Partnerships for Enhancing Expertise in Taxonomy (PEET).

Differential diagnosis. See Table 2. In addition, *E. karenae* **n. sp.** has radiating dark-orange lines on the oral disc and smaller polyps surrounding larger polyps, whereas the disc of *E. rodmani* **n. sp.** lacks radiating lines and polyps of different sizes do not differ in distribution. Many of the species of *Epizoanthus* occurring in the western Pacific Ocean differ from *E. karenae* **n. sp.** and *E. rodmani* **n. sp.** in habitat and/or substratum. The sphincter muscle of *Epizoanthus sabulosus* Cutress, 1971, which occurs in the same latitudes and depths as the new Australian species, is narrower distally than that of either *E. karenae* **n. sp.** or *E. rodmani* **n. sp.**, and has fewer alveoli. Although the size and distribution of nematocysts in *E. karenae* **n. sp.** and *E. rodmani* **n. sp.** are very similar, microbasic *b*-mastigophores in both species are generally larger than those in *E. sabulosus*, and basitrichs are not known in *E. sabulosus*.

Two species of *Parazoanthus* are externally similar to all three new species. In addition to the diagnostic differences in sphincter muscle, in *P. axinellae* (Schmidt, 1862), only large (23–33 x 12–15 µm) holotrichs were measured. No nematocyst data appear to have been published for *P. elongatus* McMurrich, 1904.

Now three species of *Epizoanthus* have been described from southern Australia, the two we describe and *E. sabulosus*. Gowlett-Holmes (2008) included in her guide to southern Australia five species of zoanthids, including another undescribed species of *Epizoanthus*. There may be others as well; an inventory of all zoanthid species present, both there and in southern California, is needed.

Acknowledgements

We gratefully acknowledge Adam Daw, Karen Gowlett-Holmes, Thierry Laperousaz, and Dr. F.G. Hochberg for their help in collecting/obtaining specimens, as well as Karen Gowlett-Holmes and Daniel W. Gotshall for permission to use their photographs.

References

Bigger, C. H. (1982) The cellular basis of the aggressive acrorhagial response of sea anemones. *Journal of Morphology*, 173, 259–278.

Burnett, W. J., Benzie, J. A. H., Beardmore, J. A. & Ryland, J. S. (1997) Zoanthids (Anthozoa, Hexacorallia) from the Great Barrier Reef and Torres Strait, Australia: systematics, evolution and a key to species. *Coral Reefs*, 16, 55–68.

Carlgren, O. (1951) The actinian fauna of the Gulf of California. *Proceedings of the United States National Museum*, 101, 415–449.

Cutress, C. E. (1955) An interpretation of the structure and distribution of cnidae in Anthozoa. *Systematic Zoology,* 4, 120–137.

Cutress, C. E. (1971) Corallimorpharia, Actiniaria and Zoanthidea. *Memoirs of the National Museum of Victoria*, 32, 89–93.

Cutress, C. E. & Pequegnat, W. E. (1960) Three new species of Zoantharia from California. *Pacific Science*, 14, 89–100.

Dunn, D. F. (1982) Cnidaria. *In:* Parker, S. (Ed.) *Synopsis and Classification of Living Organisms*. McGraw-Hill Company, New York, pp. 669–706.

Fautin, D. G. (2008) *Hexacorallians of the World*. Available from: http://geoportal.kgs.ku.edu/hexacoral/anemone2/index.cfm. [Consulted most recently Dec. 2008]

Gotshall, D. W. (2005) *Guide to Marine Invertebrates: Alaska to Baja California-2nd ed. (rev.)*. Sea Challengers, Monterey, California, USA, 117 pp.

Gowlett-Holmes, K. (2008) *A Field Guide to the Marine Invertebrates of South Australia*. Notomares, Sandy Bay, Tasmania, Australia, 333 pp.

Gray, J. E. (1867) Notes on Zoanthidae, with descriptions of some new genera. *Proceedings of the Zoological Society of London*, 15, 233–240.

Herberts, C. (1972) Étude systématique de quelques zoanthaires tempérés et tropicaux. *Tethys*, suppl. 3, 69–156.

Herberts, C. (1987) Ordre des Zoanthaires. *In:* Grassé, P. (Ed.) *Traité de Zoologie. Anatomie, Systematique, Biologie*. Masson, Paris, pp. 783–810.

Humason, G. L. (1967) *Animal Tissue Techniques*. W.H. Freeman, San Francisco, California, 569 pp.

Hyman, L. H. (1940) *The Invertebrates: Protozoa through Ctenophora*. McGraw-Hill Book Co., New York and London, 726 pp.

Manuel, R. L. (1981) *British Anthozoa: Keys and Notes for the Identification of the Species*. Academic Press, London and other cities, 241 pp.

McMurrich, J. P. (1904) The Actiniae of the Plate collection. *Zoologische Jahrbücher*, 6, 215–306.

Pax, F. (1925) Unterklasse: Hexacorallia. *Handbuch der Zoologie*, 1, pp. 770–901.

Reimer, J. D., Ono, S., Iwama, A., Takishita, K., Tsukahara, J. & Maruyama, T. (2006) Morphological and molecular revision of *Zoanthus* (Anthozoa: Hexacorallia) from southwestern Japan, with descriptions of two new species. *Zoological Science*, 23, 261–275.

Ryland, J. S., Brasseur, M. M., & Lancaster, J. E. (2004) Use of cnidae in taxonomy: implications from a study of *Acrozoanthus australiae* (Hexacorallia, Zoanthidea). *Journal of Natural History*, 38, 1193–1223.

Ryland, J. S. & Lancaster, J. E. (2003) Revision of methods for separating species of *Protopalythoa* (Hexacorallia: Zoanthidea) in the tropical West Pacific. *Invertebrate Systematics*, 17, 407–428.

Ryland, J. S. & Lancaster, J. E. (2004) A review of zoanthid nematocyst types and their population structure. *Hydrobiologia*, 530/531, 179–187.

Ryland, J. S. & Muirhead, A. (1993) Order Zoanthidea (Class Anthozoa, Zoantharia). *In:* Mather, P. & Bennett, I. (Eds), *A Coral Reef Handbook*. Surry Beatty and Sons, Sydney, Australia, pp. 52–58.

Schmidt, O. (1862) Die Spongien des Adriatischen Meeres. Wilhelm Engelmann, Leipzig, 88 pp.

Walsh, G. E. (1967) *An Annotated Bibliography of the Families Zoanthidae, Epizoanthidae, and Parazoanthidae (Coelenterata, Zoantharia)*. Hawaii Institute of Marine Biology, Honolulu, 77 pp.

Wood, R. L. (1957) Identification and microanatomical study of a new species of *Epizoanthus* (Zoanthidea). Unpublished Ph.D. dissertation, University of Washington, 82 pp.

Wood, R. L. (1958) Identification and microanatomical study of a new species of *Epizoanthus* (Zoanthidea). *Dissertation Abstracts*, 18(2), 707–708.