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Neoaiptasia morbilla new species (Cnidaria: Actiniaria), a sea anemone symbiont of sand-dwelling gastropods on Saipan, Mariana Islands, with comments on some other such associations

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Abstract -- Very small, cryptic specimens of a new species of sea anemone attach to shells of living gastropods that burrow in subtidal sand on the shores of Saipan and Tinian, Mariana Islands. We have found members of the new species, which we describe as *Neoaiptasia morbilla*, on the shells of eight species of snails that belong to five families. We modify slightly the definition of the genus *Neoaiptasia* (family Aiptasiidae) to accommodate this species. *Neoaiptasia morbilla* n. sp. is most easily distinguished when alive by its pale column with minute red spots and symbiosis with a living gastropod. In preservation, it is distinguished by its lack of cinclides, relatively weak musculature, bumps on its column, which is not divided into regions, and details of its cnidae. Specimens of *N. morbilla* n. sp. resemble those of *Paraiptasia radiata* in being symbiotic with snails and living in east Asia, but specimens of *P. radiata* are larger, have prominent longitudinal stripes, and have a column divided into scapus and scapulus. The animal now known as *P. radiata* was originally described as *Actinia radiata*, a name that has been applied to two species of sea anemones from eastern Asia.

Introduction

We have found specimens of a small sea anemone attached to shells of eight species of living gastropods that burrow in sand on the shores of Saipan and Tinian, Mariana Islands (the snails belong to five families; for details of the symbiosis, see Goodwill et al. 2009). We describe the new species as *Neoaiptasia morbilla*. The specimens we studied are sterile, and thus lack features that allow definitive generic placement, but we choose to place the new species in *Neoaiptasia* (family Aiptasiidae); most specimens of the only other known species of *Neoaiptasia* live attached to gastropod shells inhabited by hermit crabs. *Neoaiptasia morbilla* n. sp. is most easily distinguished when alive by its pale column with minute red spots and attachment to a gastropod shell. It is distinguished in preservation by its lack of cinclides, relatively weak musculature, bumps on its column, which is not divided into regions, and details of its cnidae.

Specimens of *N. morbilla* n. sp. resemble those of *Paraiptasia radiata*, which was originally described as *Actinia radiata*, in being attached to small gastropods. The name *Actinia radiata* appears to have been applied to two species of sea anemones from eastern Asia, anemones that are now referred to as *Paraiptasia radiata* (Stimpson, 1855) [sic] and *Cricophorus radiatus* (Stimpson, 1855) [sic] by England (1992) and Uchida & Soyama (2001), respectively. The name properly belongs to the former; the latter needs a new name, but additional information is required about the animal studied by Uchida & Soyama (2001) before it can be ascribed to an existing species or described as a new one.

Materials and Methods

Specimens were collected on the islands of Saipan and Tinian; all collections and shipments were made in accordance with permits issued by the Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife. We collected 52 specimens of *Neoaiptasia morbilla* n. sp. by hand, five in 1988, 19 in 2003, three in 2004, two in 2005, 14 in 2006, and nine in 2007. All were observed and photographed alive in the laboratory. All except those collected in 1988 were preserved after being relaxed in methanol; 35 were fixed in 10% formalin and stored in 70% ethanol, and 12 were preserved in 95% ethanol. Histological sections were made of five of the fixed specimens: 8 μm thick, they were stained with hematoxylin and eosin (Humason 1979). Cnidae were measured from preserved specimens in squash preparations at 1000x with differential interference contrast optics; not all tissues of all individuals were studied.

Type and voucher specimens have been deposited in the B. P. Bishop Museum Department of Marine Biology, Honolulu, Hawai'i, USA (BPBM); Brigham Young University Hawaii Museum of Natural History, Laie, Hawai'i, USA (BYUHMNH); Department of Invertebrate Zoology, California Academy of Sciences, San Francisco, California, USA (CASIZ); Division of Invertebrate Zoology, University of Kansas Natural History Museum, Lawrence, Kansas, USA (KUIZ); and Department of Invertebrate Zoology, US National Museum of Natural History, Washington, D.C., USA (Smithsonian Institution) (USNM).

Cnidae terminology is that of Mariscal (1974).

Results

Neoaiptasia morbilla new species

(Family Aiptasiidae)

Figure 1. *Neoaiptasia morbilla* n. sp. on shell of *Terebra affinis* showing characteristic red spots, bands on tentacles, and lips around mouth.

DESCRIPTION

External Anatomy and Size: In life, attached to a gastropod shell, column of uniform diameter most of length, pedal disc flared. Average length 3 mm; pedal disc diameter 5 mm; mid-column diameter about same as length. Well-expanded specimen ~4 mm long, had oral disc ~4 mm diameter, pedal disc ~5 mm diameter; one 3 mm long was 3 mm diameter at mid-column, had pedal disc ~5 mm diameter. Column uniform structure entire length, light-colored, lustrous, with many tiny red spots (circles, ovals, streaks, etc.) (Fig. 1); no cinclides discernible. Mesenterial insertions prominent as dark lines; in some individuals, spots predominantly along insertions but in others most between them. Faint bumps on longitudinal bulges between insertions may be aligned in rings around column; they do not correspond to red spots.

In preservation, column a tapering cylinder with flared, concave base; typically column length about same as mid-column diameter. Column without spots or bands, same pale yellow as tentacles, oral disc, actinopharynx. Some preserved specimens darken slightly over time. Column firm, thin; mesenterial insertions visible through it as light lines, at least near base; no cinclides discernible. Dense, scattered small bumps aligned in rings around the column in some specimens; bumps not histologically differentiated and do not form nematocyst batteries. Rare individuals entirely retracted: moderately retracted ones pyramidal, but can retract enough to flatten against shell.

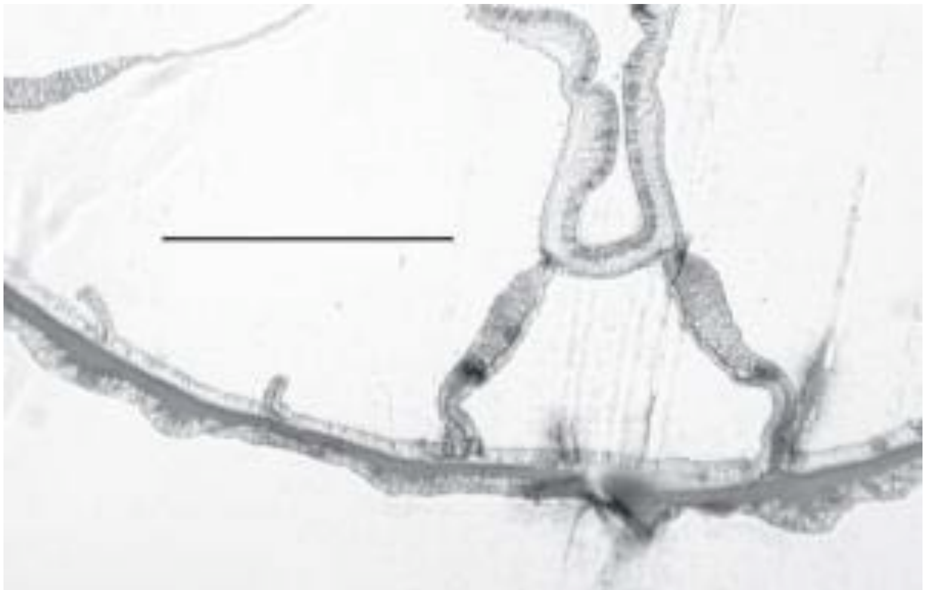

Figure 2. Cross section through mid-column of *Neoaiptasia morbilla* n. sp. showing actinopharynx and mesenteries. Scale bar = 600 μm.

Tentacles and Oral Disc: Oral disc circular to ovoid; central mouth with lips; area immediately around mouth devoid of tentacles (Fig. 1). In life, background color of disc light, but mouth area yellowish in some individuals, and some intermesenterial spaces with white patches between mouth and tentacle base. Actinopharynx deep yellow to orange.

Tapering, bluntly pointed tentacles at margin, in two cycles that may be indistinct; those of inner cycle longer, to about column diameter in length; in most individuals, 1-2 bifurcate or trifurcate. In preservation, blunt-ended; average length ~1 mm, ranging from 0.2 to 1.8 mm, basal diameter to 0.5 mm, tip about 0.2 mm. Number of tentacles in specimens studied 18-52; about 50 counted in preserved individual 5 mm long and 5 mm diameter at mid-column. Tentacles colorless; each with 3-4 narrow bands of grey or rust red equally spaced along length.

Tentacles seldom retract completely -- some visible in most specimens examined, although oral disc somewhat contracted in many.

Internal Anatomy: More mesenteries proximally than distally; to 4 cycles, only first or first two complete. Too small to determine whether mesenteries have stomata; source of acontia could not be determined. One or two pairs of directive mesenteries; directives attached to siphonoglyphs (Fig. 2). Retractor muscles diffuse, weakly developed (Fig. 2). All specimens studied sterile, so distribution of gametogenic mesenteries unknown. In the specimen that is the

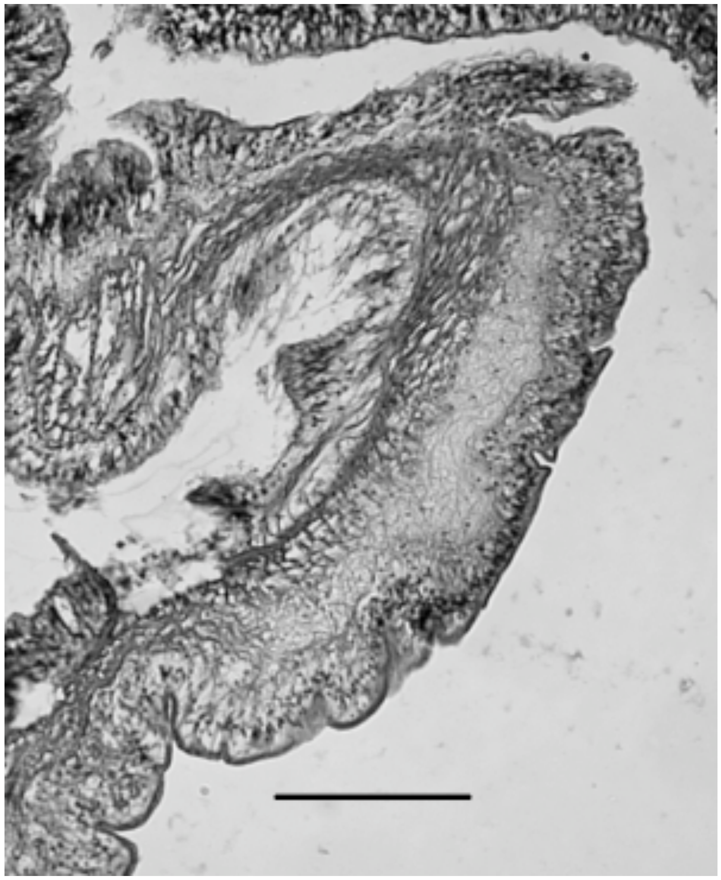

Figure 3. Longitudinal section at margin of *Neoaiptasia morbilla* n. sp. showing mesogleal sphincter muscle. Scale bar = 100 μm.

subject of Figure 2, one of the mesenteries is unpaired. Parietobasilar muscles not seen.

Marginal mesogleal sphincter muscle weak (to judge by few animals closing completely), an elongate mesh that hugs endoderm and extends width of mesoglea at distal end (Fig. 3). No cinclides seen, but column wall with some thin regions (Fig. 4).

Tentacle muscles: longitudinal ectodermal, circular endodermal.

Cnidae: See Table 1 and Figure 5. The nematocysts we identify as microbasic *p*-mastigophores appear to have a tubule distal to the shaft to judge by rare capsules that are shattered, revealing the internal contents, and a couple of fired nematocysts. Many of the nematocysts are so small that internal detail can be difficult to ascertain; for example, in the type labeled K in Figure 5, although the end of the shaft may appear flared in the image, it did not appear so when

Figure 4. Longitudinal section at margin of *Neoaiptasia morbilla* n. sp. showing thin regions in column wall (one indicated by arrow, another above it just below sphincter muscle). Scale bar = 200 μm.

focusing at multiple levels with the microscope. Every type from every tissue we studied (we could not obtain cnidae from the actinopharynx of any specimen) is illustrated so that comparisons can be made readily, except for the broad basitrichs from the acontia of a single individual.

Etymology: The name morbilla is Latin for "measles"; it refers to the animal's small red spots. Its gender is feminine.

Type Locality: Managaha Island (south side), Tanapag Lagoon, Saipan, Mariana Islands (approximately 15°14' N, 145°43' E).

TYPE AND VOUCHER SPECIEMENS

Holotype: KUIZ 1960, collected July 2003 by John Furey and RHG, whole animal attached to shell of *Rhinoclavis articulata*.

Paratypes (all collected by John Furey and RHG from type locality; CASIZ, KUIZ, USNM specimens collected 2003; BPBM specimens collected 2006): BPBM-D 1248, one uncut anemone removed from shell of *Terebra affinis*; BPBM-D1249, one uncut anemone removed from shell of *Conus pulicarius*; BPBM-D1250, one uncut anemone removed from shell of *C. pulicarius*. CASIZ 175700, one uncut anemone attached to shell of *R. articulata*. KUIZ 1949, one uncut anemone attached to shell of *R. articulata* and one detached anemone from which longitudinal sections were mounted on 11 microscope slides; KUIZ 1959, halves of two specimens attached to one shell of *R. articulata*, one half specimen bisected longitudinally with histological longitudinal sections of other half on five microscope slides, basal half of one specimen transversely bisected with histological tangential sections of other half on four microscope slides; KUIZ 1961, one uncut anemone attached to shell of *R. articulata*; KUIZ 1962, halves of two specimens not attached to shell, one specimen bisected longitudinally with

Table 1. Cnidae of *Neoaiptasia morbilla* n. sp. Letters refer to illustration of that type of capsule in Figure 5. Measurements, in μm, are range of length of undischarged capsule x its width; dimensions of single capsules falling well outside the range of the rest are indicated in parentheses. n = number of capsules measured. N = ratio of number of animals in which capsules of that type were found to number of animals examined.

	Measurements, μm	n	N
Tentacles			
Spirocyst – gracile (A)	9.1 - 20.1 x 2.2 - 3.9	25	5/5
Spirocyst – robust (B)	15.0 – 21.3 x 3.5 – 5.2	8	3/5
Microbasic *p*-mastigophore (C)	9.1 – 12.7 (13.4) x 2.8 - 4.3	20	3/5
Basitrich (D)	(11.4) 12.6 –19.1 (22.3) x 2.0 - 3.7	31	5/5
Microbasic *p*-mastigophore (E)	21.4 – 28.8 (30.7) x 2.7 – 4.8 (5.5)	60	5/5
Acontia			
Basitrich (not illustrated)	9.1 – 10.9 (12.3) x 3.5 - 4.5 (5.0)	10	1/6
Basitrich (F)	10.0 – 14.5 (16.4) x 1.3 - 2.8	61	6/6
Microbasic *p*-mastigophore (G)	30.4 – 41.2 x 5.9 – 10.1	69	6/6
Mesenterial filaments			
Basitrich (H)	8.8 – 13.5 x 1.2 - 2.3	19	4/4
Microbasic *p*-mastigophore (I)	7.1– 12.5 x 2.4 - 4.1	46	4/4
Microbasic *p*-mastigophore (J)	24.3 – 37.7 (39.5) x 4.4 – 7.3	45	4/4
Column			
Basitrich (K)	9.4 – 14.2 (14.7) x 2.0 - 3.1 (4.0)	12	2/2
Microbasic *b*-mastigophore (L)	8.5 – 13.3 (13.9) x 2.9 - 3.3	6	2/2
Microbasic *p*-mastigophore (M)	13.3 – 17.2 (18.1) x 3.2 – 4.7	13	2/2

histological longitudinal sections of other half on six microscope slides, basal half of one specimen transversely bisected with histological cross sections of other half on four microscope slides. USNM 1115599, one uncut anemone removed from shell of *R. articulata*; USNM 1115606, one specimen of *R. articulata*, the shell of which had come from the anemone in USNM 1115599.

Voucher specimens (collected by RHG and John Furey from type locality in 2006 except as specified): BYUHMNH C00016, one anemone, uncut, attached to shell of *R. articulata* collected in 2004; BYUHMNH C00017, two uncut anemones removed from shell of *R. articulata*; BYUHMNH C00019, one uncut anemone removed from shell of *Conus tessulatus*; BYUHMNH C00023, one uncut anemone removed from shell of *R. articulata*; BYUHMNH C00025, one

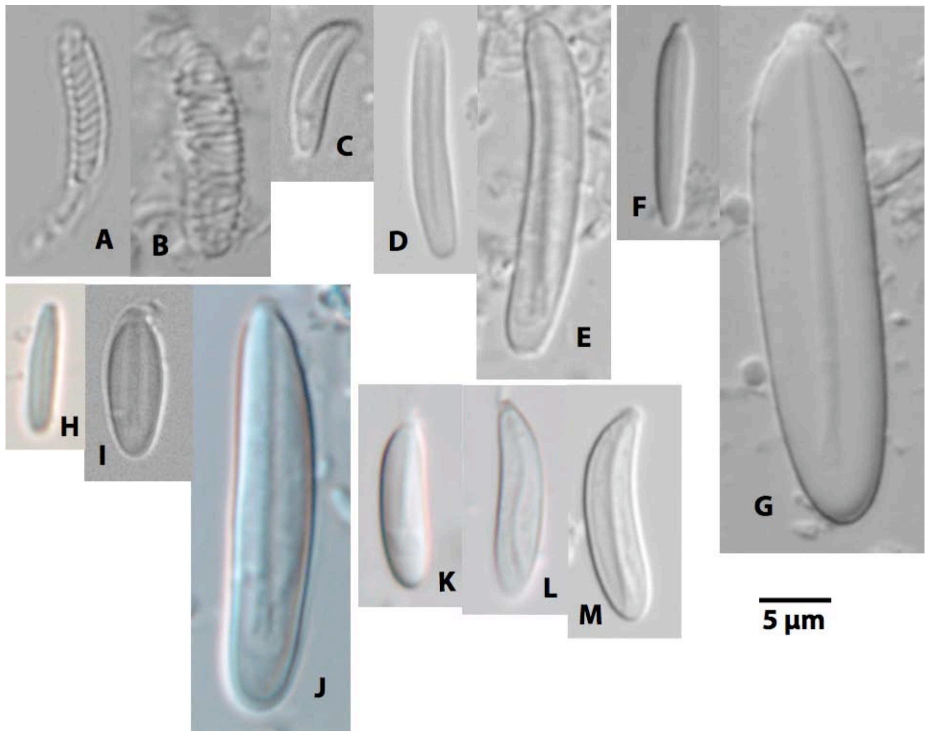

Figure 5. Cnidae of *Neoaiptasia morbilla* n. sp. For details, see Table 1. A-E from tentacles: A) Spirocyst – gracile, B) Spirocyst – robust, C) Microbasic *p*-mastigophore, D) Basitrich, E) Microbasic *p*-mastigophore. F, G from acontia : F) Basitrich G) Microbasic *p*-mastigophore. H-J from mesenterial filaments: H) Basitrich, I) Microbasic *p*-mastigophore, J) Microbasic *p*-mastigophore. K-M from column: K) Basitrich, L) Microbasic *b*-mastigophore, M) Microbasic *p*-mastigophore.

uncut anemone removed from shell of *R. articulata*; BYUHMNH C00026, one uncut anemone removed from shell of *R. articulata*; BYUHMNH C00027, one uncut anemone removed from shell of *R. articulata*; BYUHMNH C00028, one uncut anemone removed from shell of *R. articulata*; KUIZ 1954, base of one individual attached to shell of *C. pulicarius*, collected July 2003. Some of the remaining specimens have been retained by BYUHMNH, some by KUIZ, and some by Marymegan Daly at The Ohio State University.

NATURAL HISTORY

Specimens of *Neoaiptasia morbilla* n. sp. were found attached to subtidal, sand-dwelling gastropods belonging to eight species; a companion paper (Goodwill et al. 2009) deals with details of the symbiosis. One shell inhabited by a hermit crab may have borne specimens of this species. Depth of the water where they were collected ranged from 0.5 to 9 m, but no search was made below 10 m. On Saipan, the anemone seems to be restricted to Tanapag Lagoon, the largest concentration on the southern side of Managaha Island. On Tinian, it occurs in Sunharon Bay (14°57'N, 145°37'E). We have not confirmed a report by colleagues of this anemone from Tumon Bay, Guam. We searched for the anemones in other habitats, but found them only on gastropod shells; it may be that their small size and cryptic appearance made finding them elsewhere all but impossible, but we know them only as symbionts.

Discussion

FAMILY PLACEMENT

Of the currently recognized families of acontiate anemones, we choose to place this new species in Aiptasiidae. It does not conform in all respects to the definition of the family as given by Rodríguez et al. (2009), and because knowledge of the species is incomplete in some respects, future research may result in its being moved to another family. But such a shift could also result from alterations in boundaries of the family. England (1992: 89) pointed out limitations to knowledge, commenting that "A revision of this family may be necessary," and Rodríguez et al. (2007), who touched on some of the issues we discuss below, assessed Aiptasiidae as possibly not monophyletic. Examples we provide illustrate the problematic state of actiniarian taxonomy: many characters used for identification are arrayed as mosaics, presenting conundra for a hierarchical system.

Some recent descriptions of small acontiate anemones have involved redefinitions of higher taxa to accommodate the new taxon. In describing the genus *Paraiptasia*, England (1992: 89) modified the definition of family Aiptasiidae "to increase the scope and to cover new genera included in this family." As part of his justification, he provided examples of species assigned to the family with attributes contrary to the definition of the family. This problem persists: for example, Rodríguez et al. (2009) listed Aiptasiidae as being characterized by a column not divided into regions, but that is not specified by Carlgren (1924, 1949) in either the original definition or his catalog to anemones of the world, respectively. With a column divided into regions, *Paraiptasia* fits into none of the acontiate families as defined by Rodríguez et al. (2009). Both Sagartiidae and Isophelliidae have members with a column either divided into regions or not (Rodríguez et al. 2009), so variability in this feature is known within families, and unless there are reasons for restricting it, being more accommodating seems prudent until a rigorous analysis can occur.

GENUS PLACEMENT

Parulekar (1969: 62) remarked on how difficult it was to place the taxon he described: "it seems that the genus *Neoaiptasia* is intermediate, in position between Sagartiomorphidae and Aiptasiidae and with better knowledge of the genus, it may become necessary, in future, to accommodate it in a new family." He placed it in Aiptasiidae although it lacked cinclides (perforations or at least thin spots of the column through which acontia can be emitted). Although England (1992) formalized what Parulekar had implicitly done by modifying the definition of Aiptasiidae to include the absence of cinclides, Rodríguez et al. (2009) listed cinclides as a feature of Aiptasiidae. *Neoaiptasia*, too, fits into none of the acontiate families as defined by Rodríguez et al. (2009). Alone among the five genera included by England (1992) in Aiptasiidae, *Neoaiptasia* lacks cinclides. We therefore choose to assign the new species to that genus, but doing so requires slight changes in the definition Parulekar (1969) created based on the single species *N. commensali*. Our additions are italic; we remove words in brackets, and modify the underlined words for precision and clarity.

> Aiptasiidae with broad, adherent basal disc. Column smooth *or not*, undifferentiated and without cinclides. Tentaculate margin. Sphincter mesogleal, fairly well developed. Tentacles slender, <u>all</u> smooth without any projections or protuberances. Mesenteries not differenttiated into macro- and microcnemes; first *one or* two cycles (*6 or* 12 pairs) perfect and sterile. Same number of mesenteries proximally <u>and</u> distally. Acontia with basitrichs and microbasic *p*-mastigophores. Cnidom: spirocysts, microbasic p-mastigophores, microbasic *b*-mastigophores and basitrichs.

We found some but not many more mesenteries proximally than distally, and because of the small size, they were difficult to detect. We therefore consider that "Same number of mesenteries proximally and distally" describes the situation in *Neoaiptasia morbilla* n. sp. We found 6 or 12 pairs of mesenteries complete; many families, including some acontiate ones in the inventory of Rodríguez et al. (2009) are defined as having a variable number of complete mesenteries or 6-12 pairs, presumably because the number may increase as an individual grows or ages.

England (1992) differentiated among the genera of Aiptasiidae by the relative number of mesenteries at the ends of the column and the number of complete and fertile mesenteries. Number is difficult to discern in specimens as small as those we examined, all of which were sterile. When fertile specimens are collected, it might be necessary to move it to another genus or even create a new one. Likewise, if the thin spots we saw in the column (Fig. 4) turn out to be cinclides, the species will have to be moved to another genus.

DIFFERENTIAL DIAGNOSIS

Specimens of *Neoaiptasia morbilla* n. sp. differ in color, size, and habitat from those of *N. commensali*, the only species of the genus known: an individual of *N. morbilla* n. sp. is light-colored with scattered small red spots, has a basal diameter of as much as 5 mm, and lives attached to the shell of living gastropods and possibly hermit crabs, whereas one of *N. commensali* is "yellowish-brown with squarish design or irregular patches or longitudinal stripes," and has a basal diameter of 20-38 mm, and nearly all individuals live attached to gastropod shell inhabited by hermit crabs (Parulekar 1969: 58).

Fautin (2005), in describing *Anthopleura buddemeieri*, which has a red-spotted column, discussed some other similarly pigmented anemones, none of which otherwise resembles *N. morbilla*. This color pattern is shared by another member of the family Aiptasiidae, *Aiptasiogeton eruptaurantia* (Field, 1949), an individual of which has cinclides, is either pinkish-green or pinkish-yellow with 2-5 red "warts" in 10-12 longitudinal rows on the distal part of the column, has a base 4-11 mm in diameter, and lives on the east coast of the US (western Atlantic) attached to bivalve shells, barnacle tests, and other firm substrata (Field 1949: 16). The presence of cinclides, the column color, the red spots being associated with bumps, and the habitat clearly distinguish this species from *N. morbilla*.

Nor is *N. morbilla* similar to any small acontiate species of sea anemone that lives attached to gastropod shells of which we are aware. Some of those are discussed more fully below.

Some Sea Anemones Associated with Small Snails in the Tropical Pacific

Neoapitasia morbilla is the first species of anemone reported to be symbiotic with a gastropod in the Mariana Islands. In the process of comparing attributes of specimens of the new species with those of known species of anemones attached to small gastropods in the tropical Pacific, we discovered that the name *Actinia radiata*, coined by Stimpson in 1856 for an anemone from "Japan" in an account of the North Pacific Exploring Expedition, has been applied to two species of actiniarians that associate with living gastropods in the western Pacific. It was one of five new species "from the Chinese and Japanese Seas" Stimpson (1856: 375) placed in genus *Actinia*, which, at the time, was the assignment for many species now considered to belong in several families; he described it from observation of live animals, as "half an inch long" (about 13 mm), and "attached to slender univalves."

Verrill (1867: 50) published a paper that dealt largely with scleractinians but that included illustrations of several anemones "all drawn from living specimens, by Dr. Wm. Stimpson" (it continued a publication that appeared in July 1866, so is commonly dated 1866). This paper contained a line drawing, some color notes, and a collection locality (Kagosima Bay, Japan) for an anemone rendered *Sagarta radiata*. The plate was subsequently reprinted (Verrill 1868: 16), and its "explanation" bears a footnote "Since printing the former explanation of this plate (p. 50) it has been found necessary to change some of the generic names." Among the changes was the correct rendering of the word *Sagartia*. The following year, Verrill (1869: 56) first formally treated the species, listing as a

Figure 6. *Paraiptasia radiata* (Stimpson, 1856) from Singapore on a shell of *Nassarius livescens* (Philippi, 1849). Photograph by Tan Swee Hee.

synonym of it *Actinia radiata* Stimpson, and repeating much of Stimpson's original description but providing details such as the number of tentacles, and a more precise locality ("Kagosima Bay, Japan, twenty fathoms").

In 1992, England described the genus *Paraiptasia* for sea anemones he found attached to snails of the genus *Nassarius* in Hong Kong and Singapore. He designated the type species of the genus *Actinia radiata* Stimpson, 1855 [sic] (the 1856 publication was the Proceedings of the Academy of Natural Sciences of Philadelphia for 1855), listing as a synonym *Sagartia radiata* Verrill, 1868 [sic] (the plate and page number are those of the 1867 publication), and citing the 1869 publication as Verrill, 1871 (notes on the table of contents for that issue of the journal are "Author's copies issued Nov., 1869. Regular issue, March, 1870").

The guidebook to Japanese sea anemones by Hiro'omi Uchida & Soyama (2001) depicts a brownish animal 5 mm in basal diameter found at 5 m in Toyama Prefecture that the authors identified as *Cricophorus radiatus*. In the photo, it is attached near the aperture of a high-spired snail shell termed in the (Japanese language) text as *momiji bora*. Uchida & Soyama (2001) noted it was the species of anemone described by Stimpson (1855) [sic], which had not been recorded in the 150 years since Stimpson had discovered it. Uchida & Soyama (2001) did not justify placing the species in a genus of family Hormathiidae: nothing of which we are aware has been published on the internal anatomy and nematocysts of the animal depicted. Nor were the publications of Verrill and England cited.

England (1992) remarked that the oral disc of the anemone he redescribed has brown and white radial lines, and the smooth column has vertical dark (green or brown) and white lines. Both Stimpson (1856: 375) and Verrill (1869: 55-56) noted "Disk spotted with flake-white around the mouth" but the latter remarked also "Mouth radiated," and both noted the longitudinally striped column, which is obvious in the illustration (Verrill 1867, 1868). Although features used by Stimpson (1856) and Verrill (1869) do not include many of the characters important in contemporary anemone taxonomy, and no type specimens of *Actinia radiata* are known (England 1992, Fautin 2008), most features noted by Stimpson and Verrill agree with those of the species considered by England. The major discrepancy is in the number of tentacles: England (1992) counted 76-97 whereas Verrill (1869) put their number at about 40. England provided information on histology and cnidae, and a bit about live appearance, but did not note the size of the specimens he studied. One of us (DGF) found animals in Singapore (Fig. 6) that conform to both the discussion by England and the drawing published by Verrill. Typically covering much of the snail shell to which they are attached, the anemone is the same size as that reported by Stimpson (1856) and Verrill (1869), being 10-15 mm tall and across the base in life.

The redescription by England (1992) firmly ties the name *Actinia radiata* Stimpson, 1856, to the figured species, and it provides information on most features currently used in actiniarian taxonomy. Therefore, the species referred to by Hiro'omi Uchida & Soyama (2001) as *Cricophorus radiatus* needs a new name: whether it is a new species or belongs to a known one requires additional information. To complicate matters, Tohru Uchida (1932) raised the possibility that what Verrill (1869) termed *Sagartia radiata* from Kagoshima Bay might be the same as what he described from Hong Kong harbour as *Sagartia lineata*, now considered to be *Diadumene lineata* (Verrill, 1869), the most widespread species of sea anemone in the world (see Fautin 2008 for primary references). The animal redescribed by England (1992) as *Paraiptasia radiata* differs from *Diadumene lineata* in many ways as enumerated by Fautin et al. (in press) based on specimens collected in Singapore.

Animals of the species we studied are similar in size to that depicted by Uchida & Soyama (2001) but the tentacles of the animal they referred to as *Cricophorus radiatus* are longer and fewer than those of the animal we studied, and are boldly banded, and the column is brown. Individuals of *Paraiptasia radiata* are larger than animals of the species we studied, have bold, broad, longitudinal green and white stripes, and commonly close completely.

England (1987: 207) also reported having found "numerous specimens" of an unnamed species of *Actinothoe* in Singapore "on several different species of *Nassarius*." We have seen photographs of small anemones from Singapore that somewhat resemble the one termed *Cricophorus radiatus* but that may be *Neoaiptasia morbilla*; further study will be required to determine the identity of those animals.

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