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A New Species of *Phyllodesmium* Ehrenberg, 1831 (Mollusca, Nudibranchia) from the Tropical Indo-Pacific

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This paper describes a new species of aeolidoidean nudibranch of the genus *Phyllodesmium* from the tropical Indo-Pacific. *Phyllodesmium parangatum* sp. nov. is known only from the type locality in the northern Philippines. At present, there are 16 nominal species of the genus *Phyllodesmium*, most of these described by Rudman (1981b, 1991) and Baba (1949, 1991). The most recently described species, *Phyllodesmium guamensis* (Avila et al., 1998), was named from specimens collected from Guam. *Phyllodesmium parangatum* is externally similar to *Phyllodesmium magnum* and *P. guamensis.* All three of these species have flattened cerata with curved apices and highly ramified digestive gland branches within the cerata. *Phyllodesmium parangatum* has significant internal differences that clearly distinguish it from the other two species. The presence of long radular denticles and elongate denticles on the cutting edge of the jaw are among the primary differences that differentiate this species from other members of the genus.

Rudman (1981b, 1991) provided a comprehensive account of the systematics and anatomy of species of *Phyllodesmium* (Facelinidae, Aeolidina) together with physiological and ecological aspects of the use of zooxanthellae to provide supplementary nutrition to these taxa. Variation in external color pattern, ceratal shape, digestive gland ramification, radular tooth denticulation, and anal position distinguish species within this aeolid genus. Sixteen species were identified in Rudman's (1981b, 1991) and Baba's (1949, 1991) descriptions. Only one additional species had been described since Rudman's review of the genus (Avila et al. 1998).

Recent collecting trips to the Philippine Islands have provided a wealth of material that has led to descriptions of many new doridoidean nudibranch taxa (Gosliner and S. Johnson 1994; Gosliner 1995, 1996; Gosliner and Behrens 1997, 1998a, 1998b; Gosliner and Fahey 1998; R. Johnson and Gosliner 1998; 2000; Gosliner and R. Johnson 1999; Fahey and Gosliner 1999; Elwood et al. 2000; Gosliner and Valdes 2001; Dorgan et al. 2001). Members of other opisthobranch clades have been collected but have not yet been studied systematically. Found in these collections are specimens of several undescribed species of the facelinid genus *Phyllodesmium*. The purpose of this study is to describe a new species of this genus from the tropical Indo-Pacific based on materials in the Department of Invertebrate Zoology and Geology of the California Academy of Sciences (CASIZ), where type material is deposited.

***Phyllodesmium parangatum* Ortiz and Gosliner, sp. nov.**
Figures 1–5

MATERIAL EXAMINED.— HOLOTYPE: California Academy of Sciences, CASIZ 106472, near Twin Rocks, Anilao, Batangas Province, Luzon, Philippines, 15 April, 1996, T.M. Gosliner. PARATYPES: three specimens, two dissected, CASIZ 105657, Devil's Point, Maricaban Island, Batangas Province, Luzon, Philippines, 25.3 m depth, 23 February 1995, T.M. Gosliner. One specimen dissected, CASIZ 105676, Bonito Island, Maricaban Island, Batangas Province, Luzon, Philippines, 2.1 m depth, 27 February 1995, T.M. Gosliner. One specimen, CASIZ 96325, Cemetery Beach, Maricaban Island, Batangas Province, Luzon, Philippines, 13 March 1994, T.M. Gosliner.

GEOGRAPHIC RANGE.— Known only from southern Luzon Island in the Philippines (present study).

ETYMOLOGY.— The name of this species is derived from the Filipino words parang gatas, referring to the milky color of the living animals.

EXTERNAL MORPHOLOGY.— The body of the living specimens (Fig. 1) is elongate, extending broadly from the anterior to posterior end. The living animals range between 8–20 mm in length. Two preserved specimens examined (CASIZ 105657 and CASIZ 105676) measured 10.0 mm and 13.1mm respectively. The anterior end of the foot margin is broad and rounded, without prolonged corners of the foot, while the posterior end is somewhat blunt, rather than tapered. The elongate oral tentacles taper from the anterior edge of the head to form acutely pointed apices. The more blunt and thicker rhinophores are shorter than the oral tentacles and are smooth, but somewhat wrinkled in the distal half. This 30–40 thick cerata form a dense mass that largely covers the surface of the notum. The cerata are large and flattened in cross-section with an evenly curved apex that is acutely pointed at its tip. The more anterior cerata appear to be larger than more posterior ones.

The ceratal arrangement is complex with both single and double vertical rows inserted on distinctive ridges. There is one double row of precardiac cerata on each side of the body containing up a total of up to 14 cerata. On the right side, the genital aperture is found immediately below the precardiac double row. The renal opening is situated on the right side of the body, centered within the interhepatic space. The postcardiac cerata are arranged in vertical rows on both sides of the body. The first two postcardiac rows on the right side are separated by the anal papilla, which is located at the edge of the mantle, immediately behind the uppermost ceras of the first postcardiac row. There can be up to 15 cerata within each ceratal row. The remainder of the postcardiac cerata is arranged in clusters of double rows. There are about 6 postcardiac double rows, each one containing up to 10 cerata of various lengths.

COLOR.— The body color of living specimens varies only slightly between the six different individuals examined. The body wall ranges from a translucent white to an opaque milky yellow with a brownish tinge. On one of the specimens an opaque medial band of the digestive gland is visible from just behind the rhinophores to the posterior of its bluish colored body wall. The cerata often have a brownish tinge with dull white borders and apex or a milky yellow appearance with an off-white color on the upper half of their tips. The rhinophores and oral tentacles are translucent white or milky yellow in most of the specimens.

CERATA AND DIGESTIVE GLAND.— The cerata are flattened and smooth, terminating in a sharply curved ceratal apex. The digestive gland ducts extend throughout the cerata. Secondary branches occur perpendicular to the axis of the primary ceratal duct. Within each one of these secondary branches, tertiary branching occurs. These terminal branches extend in close proximity to

FIGURE 1. *Phyllodesmium parangatum* sp. nov. Living animal (CASIZ 105676).

the ceratal wall. Dense clusters of branches extend all along the central digestive duct and are visible through the translucent ceratal tissue (Fig. 2).

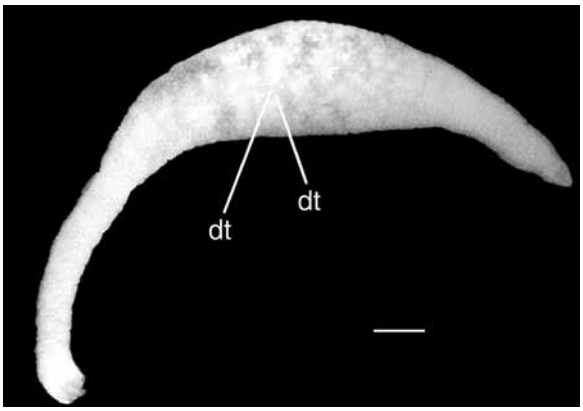

FIGURE 2. *Phyllodesmium parangatum* sp. nov. Single ceras with branching of digestive gland visible, dt = digestive gland tract. Scale bar = 0.1 mm.

BUCCAL ARMATURE.— The radular formula is 23 × 0.1.0 and 24 × 0.1.0 in two specimens examined. Each tooth consists of a narrow and somewhat short base extending to the posterior edge of the tooth in front (Figs. 3A, 4C). The central cusp is short and triangular with an acutely pointed apex. On the ventral portion of the tooth a thick rib extends from the apex of the central cusp to the posterior end of the tooth (Fig. 3B). This rib probably provides structural support for the tooth as it widens abruptly near the posterior margin of the tooth. Denticulation extends only halfway along the edge of the margin on each tooth. On each side of the radular tooth, there are 13 to 17 thin, elongate denticles with acutely pointed apices (Figs. 3C, 4D). The denticles are well-separated from each other or may be more closely spaced. The length of the denticles varies considerably. In general more basal denticles are shorter than those in closer proximity to the central cusp. The jaws (Fig. 4A) are thick and elongate, widest anteriorly. The cutting edge of the jaw plate has 8 well-separated triangular denticles that are acutely pointed distally. The lowermost denticles are more elongate and

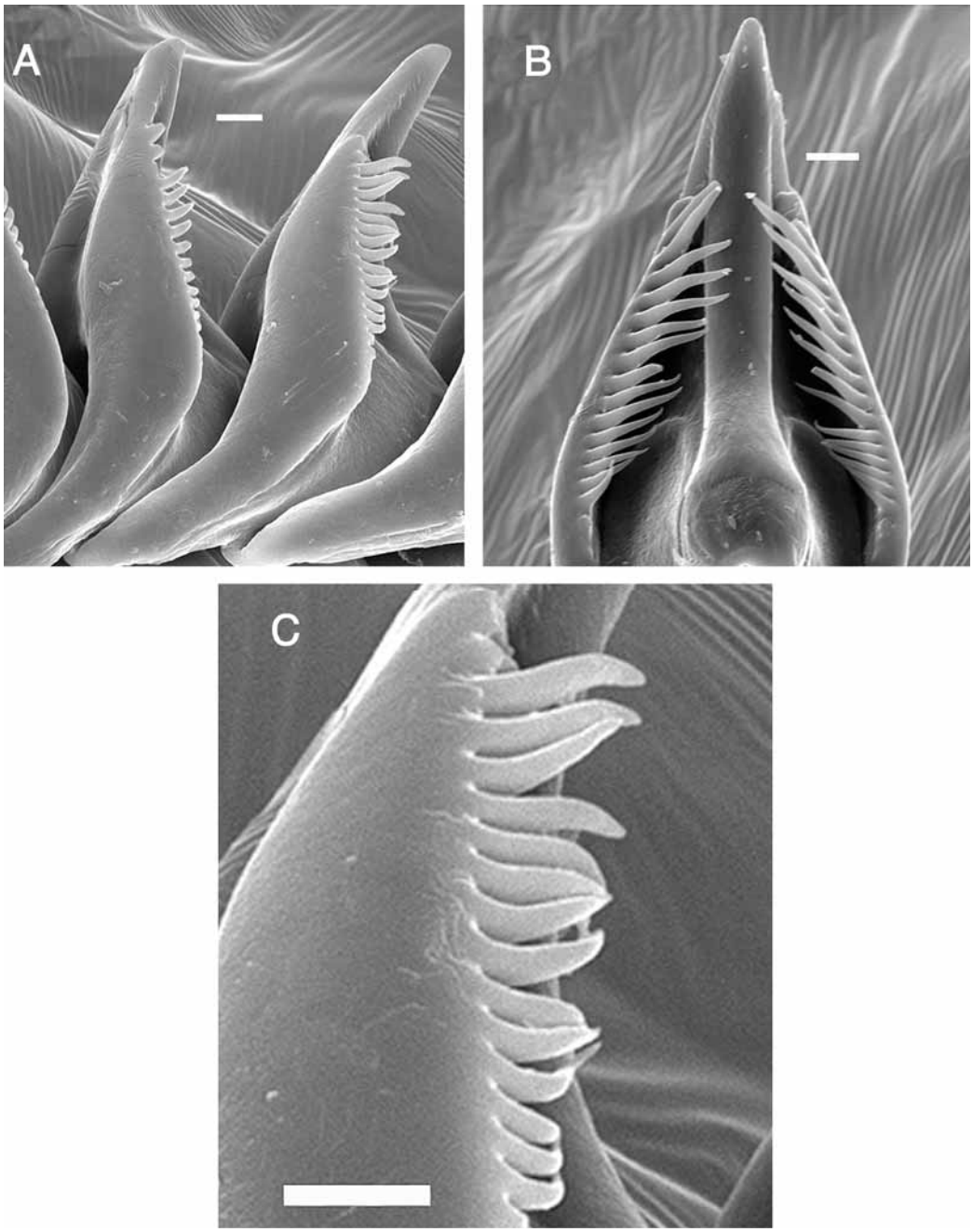

FIGURE 3. *Phyllodesmium parangatum* sp. nov. (CASIZ 105676). Scanning electron micrographs of radula. A. Lateral view of radula, scale bar = 30 µm. B. Ventral view of radular tooth, scale bar = 30 µm. C. Denticulation of masticatory margin of tooth, scale bar = 30 µm.

become successively shorter near the jaw apex (Fig. 4B).

REPRODUCTIVE SYSTEM.— The reproductive organs are arranged as a simple androdiaulic system (Fig. 5). A very long and narrow preampulla extends into a much shorter, convoluted

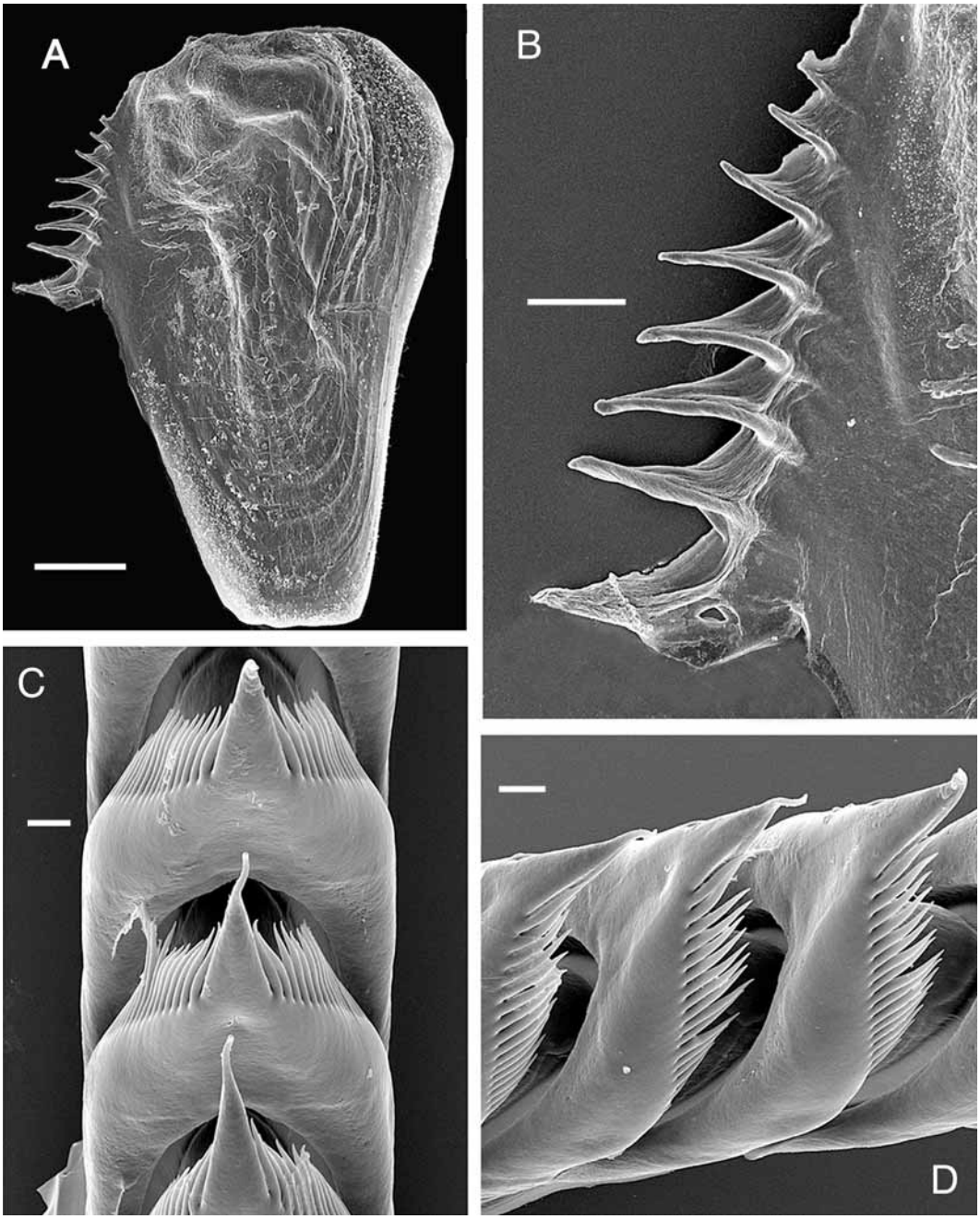

FIGURE 4. *Phyllodesmium parangatum* sp. nov. (CASIZ 105657). Scanning electron micrographs: A. Jaw, scale bar = 0.25 mm. B. Masticatory margin of jaw, scale bar = 0.08 mm. C. Dorsal view of radula, scale bar = 30 μm. D. Lateral view of radula, scale bar = 30 μm.

ampulla. The ampulla again narrows and divides into the vas deference and oviduct. The oviduct enters the female gland mass adjacent to the elongate, pyriform receptaculum seminis. The female gland mass was not fully mature in the any of the specimens dissected. The male duct is long, con-

volute, and massive. It extends from its division from the ampulla into the short, straight prostate, which is situated adjacent to the small, folded female gland mass. The vas deferens expands into a curved muscular duct that widens into the musculariz ed penial bulb. The penial bulb does not contain a distinct penial papilla and is devoid of any cuticularization or armature.

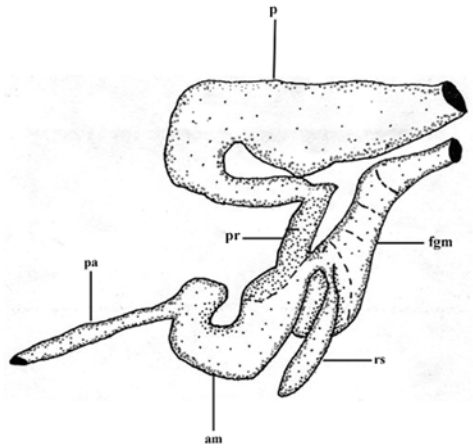

FIGURE 5. *Phyllodesmium parangatum* sp. nov. (CASIZ 105676). Reproductive system, am = ampulla, fgm = female gland mass, p = penis, pa = preampullary duct, pr = prostate, rs = receptaculum seminis. Scale = 0.5 mm.

DISCUSSION

Phyllodesmium parangatum sp. nov. is externally similar to *Phyllodesmium magnum* Rudman (1991) and *Phyllodesmium guamensis* Avila, Ballesteros, Slattery, and Paul (1998). All three species have curved ceratal apices and highly branched digestive gland tissue within the cerata. The distinctive elongate radular denticles, the large and elongate denticles on the cutting edge of the jaw, the vertical postcardiac rows along its dorsum and the position of the anal papilla (which lies at the edge of the mantle immediately behind the uppermost cerata of the first postcardiac row), distinguish *P. parangatum* from the other two species.

Phyllodesmium magnum is a larger species, reaching approximately 40mm in length. It lacks denticles on its radular teeth, has elongate rhinophores, and a smooth masticatory margin of the jaw (Rudman 1991, present study). These characteristics clearly differentiate *P. magnum* and *P. parangatum*. *Phyllodesmium guamensis* (Avila et al., 1998) may be distinguished from *P. parangatum* by its brownish grey body color, a double row of short denticles on the radular teeth, a smooth masticatory margin of the jaw.

Other species of *Phyllodesmium* have external differences that clearly distinguish them from *P. parangatum. Phyllodesmium iriometense* (Baba,1991) has a translucent white body more simply branched digestive gland within the cylindrical, straight cerata, postcardiac ceratal arches, an anal papilla on inside of the first postcardiac ceratal arch and tentacular anterior corners of the foot. None of these features are present in *P. parangatum. Phyllodesmium horridum* (Macnae, 1954) and *Phyllodesmium serratum* (Baba, 1949) have pink pigment on the cerata and a pink longitudinal medial line on the notum. They also have more simply branched digestive gland ducts and tentacular anterior corners of the foot. *Phyllodesmium opalescens* (Rudman, 1991) has opaque white medial diamonds on the notum and blue pigment on the ceratal apices, rhinophores and oral tentacles that are absent in *P. parangatum. Phyllodesmium opalescens* also has simple, undivided digestive gland ducts within the cerata. *Phyllodesmium pecten* (Rudman, 1981), *Phyllodesmium crypticum* (Rudman, 1981) and *Phyllodesmium hyalinum* (Ehrenberg, 1831) possess nodulose cerata and an arch rather than a double row of cerata in the first precardiac cluster.

Phyllodesmium macphersonae (Burn, 1962) possesses few ceratal clusters, cylindrical cerata and is very small in size. *Phyllodesmium longicirrum* (Bergh, 1905) also differs from *P. parangatum* by its large body size (up to 100 mm in length) by the absence of denticles on the small radular teeth, a small number of ceratal clusters and the large ceratal surface area. *Phyllodesmium kabiranum* (Baba, 1991) can be distinguished by from *P. parangatum* by radular teeth with a short cusp,

flanked by short denticles, the presence of precardiac ceratal arches, nodular cerata and an anal papilla on outside of postcardiac ceratal group. *Phyllodesmium briareum* (Bergh, 1896) and *Phyllodesmium colemani* (Rudman, 1991) differ in having a narrow anterior foot, long, smooth rhinophores, smooth cutting edge of jaw and longer radular denticles.

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