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Re-description of *Parabunodactis imperfecta* Zamponi & Acuña, 1992 from the Patagonian Argentinean coast

(Anthozoa, Actiniaria)

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One of the most conspicuous and abundant species of sea anemones from the intertidal zone of Puerto Madryn, Argentina, is re-described and its generic diagnosis amended. Its distribution is expanded towards the north.

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Introduction

The identification of sea anemones requires characteristics that can only be seen through dissection and on histological slides, and can only be interpreted by specialists. Furthermore, in vivo photos add information such as colour, shape and size that can help to already identify specimens in the field that are hard to differentiate in preserved state, but easily distinguished alive (Häussermann 2004). Therefore redescriptions of the numerous species including characteristics of in vivo and preserved specimens are needed to enable biologists to identify these animals and thus include them into their studies and monitoring programs.

Zamponi & Acuña (1992) studied the diversity of sea anemones from the intertidal zone of Puerto Madryn (Chubut) based on preserved material collected in 1980. They found one corallimorpharian (*Sphincteractis sanmatiensis* Zamponi, 1976) and five actiniarians: *Antholoba achates* (Drayton in Dana, 1846), *Anemonia chubutensis* Zamponi & Acuña, 1992; *Phlyctenanthus regularis* Zamponi & Acuña, 1992, *Parabunodactis imperfecta* Zamponi & Acuña, 1992 and *Isophellia madrynensis* Zamponi & Acuña, 1992. The latter four were newly described and have not been found again. Since the material was described based on fixed specimens there are no data regarding colour or live characteristics. Therefore we redescribe *P. imperfecta* including new information on live specimens and on distribution.

Materials and Methods

The examined specimens were collected by Daniel Lauretta (DL) from the intertidal zone or by scuba-diving down to ten meters depth in Las Grutas (40°48'S, 64°04'W), Villarino beach (42°24'47"S, 64°17'38"W), Punta Pardelas (42°37'09"S; 64°15'53"W), Punta Delgada (42°46'02"S, 63°38'07"W), Puerto Madryn (42°46'12"S, 64°59'40"W) and Punta Ninfas (42°58'03"S, 64°18'47"W) (Fig. 1). The specimens were carefully removed from the substratum with a sharp tool. Photographs of in vivo specimens were taken, both in situ and in the aquarium. The specimens were relaxed: they were kept in cold oxygenated water with menthol crystals scattered on the

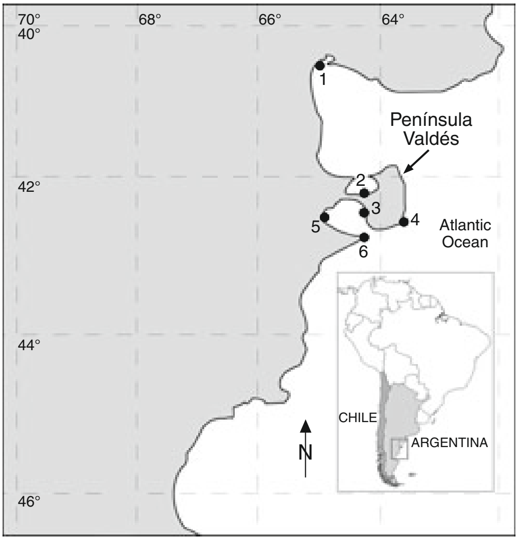

Fig. 1. Distribution of *Parabunodactis imperfecta* in Argentina. **1**, Las Grutas; **2**, Villarino beach; **3**, Punta Pardelas; **4**, Punta Delgada; **5**, Puerto Madryn; **6**, Punta Ninfas.

surface. Once the specimens stopped responding to tactile stimulation, they were fixed in 4 % formalin in seawater, and after a few months they were transferred to 70 % alcohol for storage. Longitudinal and transverse sections of the whole animal or of a part of it, depending on its size, were performed. Therefore five specimens of *P. imperfecta* were dehydrated, embedded in paraffin, cut in sections of five to ten µm, and stained with Azocarmin triple stain.

The distribution of the cnidae of *Parabunodactis imperfecta* in the tissues was analyzed in four recently collected specimens and in the holotype of *P. imperfecta*. The distribution of the cnidae was also studied in *Parabunodactis inflexibilis;* using a light microscope (100× oil immersion). The present cnida types for each tissue were determined. Of each cnida type, 40 non-fired capsules were counted (if possible) and measured. For better identification of the capsules, some fired capsules were observed in each tissue. Mean and standard deviation were calculated. Nomenclature proposed by England (1991) was followed.

Material examined. *Parabunodactis imperfecta*, two specimens, leg. DL, Villarino beach, 42°24'47"S; 64°17'38"W, intertidal zone, 10.2007, 4 % formalin, Museo Argentino de Ciencias Naturales – Coleccion Nacional de Invertebrados.

Comparative material examined

Parabunodactis imperfecta Zamponi & Acuña, 1992. Holotype (p. 46-48, fig. 8-10) [Colección del Museo de La Plata Nº 8512]. Type locality 42°45'S, 65°03'W. Intertidal zone. Col. Ramírez-Bastida.

Parabunodactis inflexibilis (Carlgren, 1928). Syntype (two specimens) (p. 162-164, fig. 20 and 21). Type locality India, southwest of Great Nikobar – Deutsche Tiefsee-Expedition (Valdivia) 1898-1899 station 208. 6°54'N, 93°28,8'W. 296 m. [Swedish Museum of Natural History: SMNH Type-3995].

Results

Actiniidae Rafinesque, 1815

Parabunodactis Carlgren, 1928

Parabunodactis imperfecta Zamponi & Acuña, 1992

Parabunodactis imperfecta – Zamponi & Acuña 1992, p. 46-48, fig. 8-10; Zamponi et al. 1998, p. 35, 36, 38 and 40; Rodríguez et al. 2007, p. 1881.

Amended diagnosis of the genus *Parabunodactis* (Changes regarding Carlgren 1949 and Zamponi and Acuña 1992 in bold). Actiniidae with well developed pedal disc. Column thick with 48 longitudinal rows of very large verrucae distributed over almost the whole surface. Sphincter strong, circumscribed. Fosse distinct. Tentacles rather short, about 96 with strong mesogloeal thickenings on their abaxial side. Longitudinal muscles of tentacles ectodermal, radial muscles of oral disc meso-ectodermal. Two distinct siphonoglyphs. **All stronger mesenteries perfect** and fertile, **directives sterile**. Retractors well developed, band-like. Parietobasilar muscles strong, forming a fold. Cnidom: spirocysts, basitrichs, microbasic p-mastigophores.

Differential diagnosis. *Parabunodactis imperfecta* differs from *Parabunodactis inflexibilis* (Carlgren, 1928), the most similar species, in geographic distribution (Argentina, Atlantic ocean vs. Great Nicobar Island, Bay of Bengal, Indic ocean), habitat (intertidal and shallow subtidal vs. deep water, 296 m), presence of cinclides and cnidae (no spirocysts in pedal disc of *P. inflexibilis* and bigger basitrichs in tentacle apex of *P. inflexibilis* (32,5 µm × 2,6 µm vs. 25,3 µm × 2,4 µm).

External features

Pedal disc. Broader than column: up to 35 mm diameter; irregular round shape; robust; yellowish; sometimes reddish. Strongly attached to substratum.

Column. In vivo, considerably higher than broad (Fig. 2a); in preserved specimens less obvious, sometimes even wider than high; green or light red, with red spots in longitudinal lines. Fosse and parapet present. Cinclides present in upper column. Verrucae dark red; forming 40 to 50 clear longitudinal lines corresponding to endocoels (Fig. 2b,c); separated and clearly differentiable towards margin, but closer

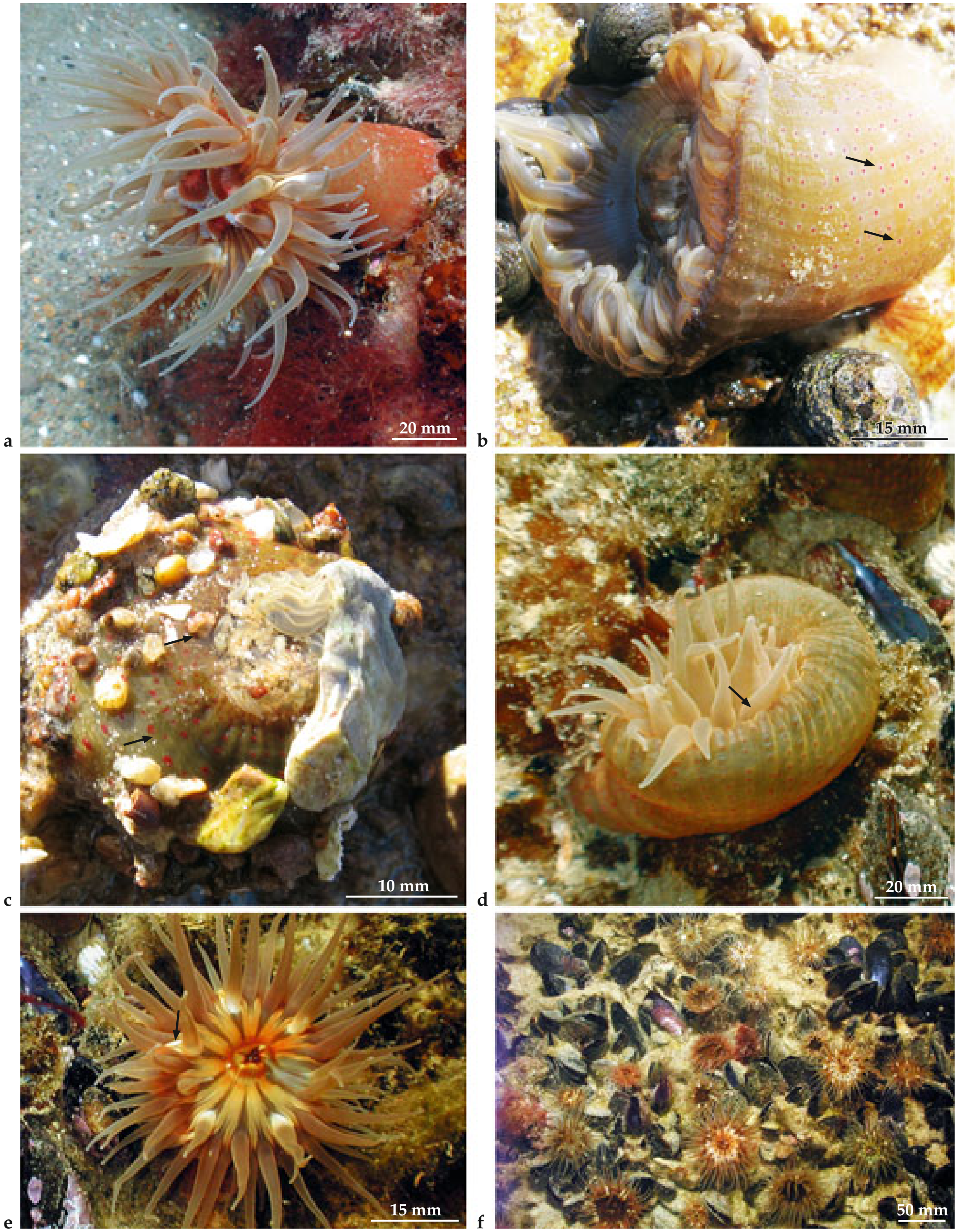

Fig. 2. *Parabunodactis imperfecta* in the habitat. **a,b.** Lateral view. Arrows in B indicate vertical line of verrucae. **c.** Specimen fallen dry in the intertidal. Arrows point to verrucae and attached material. **d.** Partly retracted specimen. Arrow points to pseudoacrorhagi. **e.** View of the oral disc. Arrow indicates light lines leading around the base of the tentacles of the first cycle. **f.** Group of specimens between mytilids. Photographs a, d, e and f taken by Günter Försterra in Punta Pardelas at 4-5 m depth. Photos b and c taken by Daniel Lauretta in the intertidal zone of Las Grutas.

together towards limbus, making differentiation difficult. About 20 verrucae per line (12 in a small specimen, 30 in a big one). Pseudoacrorhagi present (Fig. 2d) with basitrichs in batteries. One type of basitrichs clearly different from those of the column (Fig. 3g B).

Tentacles. Up to 108; hexamerously arranged; white or light pink (Fig. 2e) in preserved specimens; long with strong mesogloeal thickenings on abaxial side (Fig. 3e); inner longer than outer; without apical pore. Tentacles cover ⅓ of oral disc and can fully be covered by column when retracted.

Oral disc. Circular; wider than column; light green or light red, with dark green, yellowish or whitish radial lines (Fig. 2e). Clear lines at base of tentacle of first cycle in most specimens (Fig. 2e). Mouth circular or triangular; usually not elevated. Siphonoglyphs externally not evident.

Anatomy. Up to 112 mesenteries in five cycles; last cycle incomplete; same number proximal and distal. All stronger mesenteries perfect. Two pairs of directives associated to siphonoglyphs (Fig. 3a). Siphonoglyphs with well developed reticulated pad (Fig. 3a). All mesenteries fertile except directives (two fertile specimens, both female). Retractor muscles strong; diffuse (Fig. 3b); circumscribed in largest mesenteries. Parietobasilar muscles well developed; with free pennon (Fig. 3b). Basilar muscles distinct; strong (Fig. 3c). Sphincter endodermal; circumscribed, strong (Fig. 3d). Longitudinal muscles of tentacles ectodermal to ecto-mesodermal (Fig. 3e). Circular muscles of oral disc meso-ectodermal (Fig. 3f). Oral and marginal stomata well developed in all mesenteries; oral stoma approximately double than distal stoma.

Ectoderm and endoderm of regular width (0.06 to 0.1 mm). Mesogloea of irregular width; up to 0.2 mm wide.

Cnidom. Spirocysts, basitrichs, microbasic p-mastigophores and microbasic b-mastigophores (Fig. 3g). For distribution and size see Table 1.

Distribution and Natural history. *Parabunodactis imperfecta* was found at each examined site, from Las Grutas to Punta Ninfas (Fig. 1). It is generally found both in the intertidal and subtidal down to 20 m (Fig. 2f), and was the dominant species in the intertidal where it was found. Specimens were found in tide pools and under rocks, both in protected and

Table 1. Size and distribution of cnidae of specimens of Parabunodactis imperfecta. Abbreviations: "n" is the number of capsules measured; "N" is the proportion of specimens with respective type of cnidae present.

Tissue/Cnida type	Length (µm)	Mean (µm)	Standard deviation (µm)	Width (µm)	Mean (µm)	Standard deviation (µm)	n	N
Pseudoacrorhagi								
Basitrichs 1 (A)	17.0-23.0	19.4	1.6	1.0-2.0	1.7	0.3	22	3/3
Basitrichs 2 (B)	26.0-42.0	31.8	4.2	1.5-3.0	2.3	0.4	18	3/3
Spirocysts (C)	25			2			1	2/3
Tentacles								
Spirocysts (D)	13.0-23.7	19.7	2.8	1.5-3.0	2.3	0.3	40	5/5
Basitrichs (E)	15.3-23.8	20.2	2.0	1.7-3.3	2.5	0.3	41	5/5
Column								
Basitrichs (F)	10.1-26.8	19.5	2.5	1.5-3.5	2.2	0.4	46	5/5
Spirocysts (G)	26.3-28.6	22.6	4.4	2.5-3.2	2.5	0.4	4	5/5
Pedal disc								
Spirocysts (H)	15.1-22.1	18.2	2.7	2.1-2.9	2.6	0.3	5	5/5
Basitrichs (I)	16.2-24.1	18.4	1.4	1.8-2.8	2.3	0.3	43	5/5
Pharynx								
Basitrichs (J)	22.9-29.5	26.9	1.5	2.5-3.8	3.0	0.3	40	5/5
Microbasic p-mastigophores (K)	22.0-24.5	23.3		4.4-5.0	4.7		2	4/5
spirocysts (L)	22.8-25.2	23.5		2.3-2.7	2.6		4	3/5
Mesenterial filaments								
Basitrichs (M)	9.8-24.5	13.4	3.7	1.3-3.2	2.0	0.4	71	5/5
Microbasic p-mastigophores (N)	17.3-28.7	21.9	2.4	2.8-8.1	4.8	1.0	48	5/5
Microbasic b-mastigophores (O	27.8-39.1	31.9	2.6	4.0-7.2	5.6	0.8	40	5/5
Spirocysts (P)	18.9-29.4	24.0	3.0	2.0-2.7	2.5	0.2	11	4/5

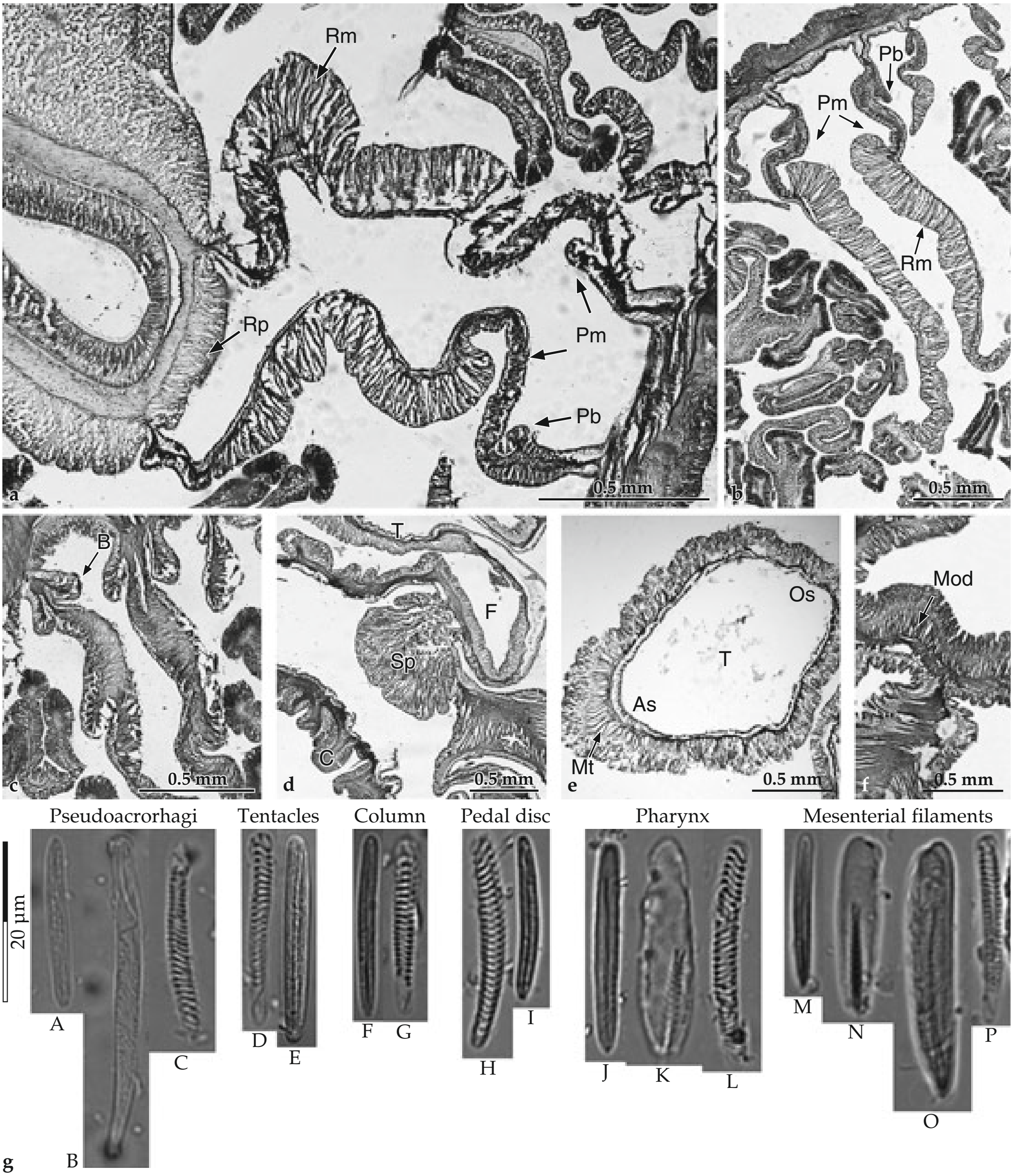

Fig. 3. a-f. Internal features of *Parabunodactis imperfecta*. **a.** Directives and siphonoglyph. **b.** Transverse section showing pair of mesenteries. **c.** Longitudinal section through pedal disc. **d.** Longitudinal section through margin. **e.** Cross section through tentacle. **f.** Longitudinal section of oral disc. **As**, adoral side of tentacle; **B,** basilar muscles; **C,** column; **F,** fosse; **Mod**, circular muscles of oral disc; **Mt**, endodermal muscles of tentacle; **Os**, oral side of tentacle; **Pb** parietobasilar muscles; **Pm**, pair of mesenteries; **Rm**, retractor muscles; **Rp**, reticulated pad; **Sp**, sphincter; **T**, tentacle. **G.** Cnidome of *Parabunodactis imperfecta.* Letters see Table 1.

exposed areas. The specimens were usually covered with shell fragments and small stones (Fig. 2c), which gave them a good camouflage. Specimens kept in aquarium expanded quickly when exposed to light. Specimens quickly re-attach to the substrate. When contracted, water was expelled from the cinclides.

Discussion

This paper completes the original description of *Parabunodactis imperfecta*, adding formerly missing information on tentacle number, distribution of fertile mesenteries, and presence of pseudoacrorhagi. Additional cnida types were found and descriptive statistics based on at least 40 unfired capsules (according to Williams 1996) added. In addition, images of histological slides are given including basilar muscles, which are not mentioned in the original description. The re-description also includes new information on in vivo color and its variation.

The holotype of *Parabunodactis imperfecta* is contracted and twisted, which makes the study of location and form of the mesenteries difficult. Under stereo microscope in well preserved specimens it can be clearly seen that all mesenteries are perfect. Towards the pedal disc, in some specimens, the younger mesenteries show an inverted "U" shape. In a transverse section of this area, perfect mesenteries and "imperfect" mesenteries can be seen. These "imperfect" mesenteries, however, are either attached to the column or to the pharynx, and are truly perfect mesenteries. A similar effect is produced by cutting a mesentery through a marginal stoma (Stephenson 1928). The holotype presents both perfect and "imperfect" mesenteries, as described earlier.

The few differences in cnida type that we found in our comparison between specimens collected by us and the holotype concern the data published by Zamponi & Acuña (1992). They did not mention the cnidae of pedal disc and pseudoacrorhagi. Based on our analysis of the fired capsules, their microbasic b-mastigophores are truly basitrichs. They did not find spirocysts in the pharynx or microbasic b-mastigophores in the mesenterial filaments. This could be due to a low number of analyzed capsules (we only found six spirocysts in the pharynx and two microbasic b-mastigophores in the mesenterial filaments of the holotype after analyzing several samples). Finally, we did not find the microbasic p-mastigophores reported in tentacles and column neither in the holotype nor in our samples. This difference could be due to contamination or low cnida quantities in the mentioned tissues.

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