



Errina argentina sp. nov., a new stylasterid (Hydrozoa: Stylasteridae) from Mar del Plata submarine canyon (Southwest Atlantic)

M. C. Bernal¹ · S. D. Cairns² · P. E. Penchaszadeh¹ · D. Lauretta¹

Received: 2 November 2017 / Revised: 20 February 2018 / Accepted: 21 February 2018

© Senckenberg Gesellschaft für Naturforschung and Springer-Verlag GmbH Germany, part of Springer Nature 2018

Abstract

Errina is a cosmopolitan genus of arborescent stylasterids that includes, discounting *Errina cyclopora* incertae sedis, 26 recent species and one extinct species. So far, only one species has been described from the Southwest Atlantic (SWA) off Argentina, *Errina antarctica*. Here, we describe a new species from that region, *Errina argentina*, collected in the Mar del Plata submarine canyon at 1398m depth. The new species is most similar to *Errina kerguelensis* in general growth form, arrangement of pores, and coenosteal texture, but differs in coenosteal strip width, gastrostyle and gastropore tube morphology, ampullae position, and the presence of numerous flush dactylopores. It differs from *E. antarctica* in coenosteum color, gastropore and dactylopores spine size, and shape of flush dactylopores. This record provides an extension of the present known distribution of the genus *Errina* in the SWA off Argentina.

Keywords Argentina · Biodiversity · Deep sea · Taxonomy

Introduction

Stylasteridae Gray, 1847, consisting of 315 species (Cairns 2015, 2017), is a family of calcareous marine invertebrates belonging to the Phylum Cnidaria, Class Hydrozoa. These hydrozoans live from Antarctica to the Arctic Circle at depths of 0–2789 m, although most of the known species occur at depths between 200 and 1200 m (Cairns 1991). They grow in colonies, most of them attached to hard substrates, by secreting a calcium carbonate base and an arborescent (sometimes lamellate) skeleton, which can be fragile or more robust, uniplanar or bushy, and often with anastomotic branching. Their skeleton can be white,

orange, red, purple, pink, brown, sulfurous yellow, or green (Cairns 2015) and serves as substrate and shelter for other marine invertebrates, such as cyanobacteria (Puce et al. 2009), boring algae (Pica et al. 2016; Tribollet et al. 2017), copepods (Zibrowius 1981), pedunculate barnacles (Pica et al. 2015, Bernal Pers. Obs.), hydroids (Bernal Pers. Obs.), sponges (Pica et al. 2012, Bernal Pers. Obs.), echinoderms (Bernal Pers. Obs.), sea anemones (Lauretta Pers. Obs.), and gastropods (Goud and Hoeksema 2001; Wisshak et al. 2009; Braga-Henriques et al. 2010), granting stylasterids a role in the benthic community as coral-bank builders. Moreover, enduring organisms such as stylasterids, and hydroids in general, are recognized as a neglected component of animal forests (Di Camillo et al. 2017), so that further information is necessary in order to understand their function and vulnerability in benthic communities.

At present, 16 stylasterid species are known from the Southwest Atlantic (SWA) off Argentina (Table 1). Concerning the latitudinal range, we studied the Mar del Plata submarine canyon and its surroundings, from 37° 49' 40" to 38° 11' 44". The only records of stylasterids in geographically close areas concern five species described by Moseley (1876, 1879) from *Challenger* station 320, made in 1876, and one species described by Cairns (1983) from R/V *Vema* station 17-RD14 made in 1961. The five stylasterid species from *Challenger* station 320 are *Inferiolabiata labiata* (Moseley, 1879), *Sporadopora dichotoma* (Moseley, 1876), *Stellapora echinata*

This article is registered in ZooBank under urn:lsid:zoobank.org:pub:B4731C3D-2D97-4E1B-88D6-C0FF648A19ED

Communicated by B. W. Hoeksema

✉ M. C. Bernal
carobernal90@gmail.com

¹ Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”- CONICET, Av. Ángel Gallardo 470, Buenos Aires, Argentina

² Department of Invertebrate Zoology, Smithsonian Institution - Department of Invertebrate Zoology NW, Washington DC, Washington 20560, USA

Table 1 Listed species of stylasterids known in the SWA off Argentina, including distributions and depth ranges

Species	Distribution	Depth (m)
<i>Adelopora pseudothyron</i> Cairns, 1982	Scotia Ridge, Drake Passage, Chile Rise, and Eltanin fracture zone, south Pacific	298–915
<i>Cheiloporidion pulvinatum</i> Cairns, 1983	Off Mar del Plata and off Cape Horn	642–1137
<i>Conopora verrucosa</i> (Studer, 1878)	New Zealand region, New Caledonian Region, western Indian Ocean, subantarctic South America and Antarctic region	198–2355
<i>Crypthelia formosa</i> Cairns, 1983	Scotia Ridge from Tierra del Fuego to South Georgia	483–1841
<i>Errina antarctica</i> (Gray, 1872)	Southwestern Chile, Tierra del Fuego, Burdwood Bank and Malvinas Islands	18–771
<i>Errina cyclopora</i> incertae sedis Cairns, 1983	Scotia Ridge, east of Burdwood Bank	1647–2044
<i>Errinopora cestoporina</i> Cairns, 1983	East of Burdwood Bank and off Tierra del Fuego	359–384
<i>Errinopsis reticulum</i> Broch, 1951	Area between Tierra del Fuego, Burdwood Bank and Malvinas Islands	250–771
<i>Inferiolabiata labiata</i> (Moseley, 1879)	Antarctica, Argentina, Scotia Ridge, Ross Sea, Scott Island, Balleny Islands, Antipode Islands	87–2100
<i>Inferiolabiata lowei</i> (Cairns, 1983)	Off Argentina, Burdwood Bank, South Georgia, Drake Passage, New Zealand region	164–960
<i>Lepidopora granulosa</i> (Cairns, 1983)	Malvinas Plateau, Scotia Ridge from Tierra del Fuego to Shag Rocks	357–1874
<i>Lepidotheca fascicularis</i> (Cairns, 1983)	New Zealand region, New Caledonian Region, Scotia Ridge from Tierra del Fuego to South Georgia	274–2100
<i>Sporadopora dichotoma</i> (Moseley, 1876)	Off Argentina, Malvinas Plateau, Scotia Ridge from Tierra del Fuego to South Georgia, South Shetland Islands	250–1498
<i>Stellapora echinata</i> (Moseley, 1879)	Off Argentina and Burdwood Bank	357–1647
<i>Stylaster densicaulis</i> Moseley, 1879	Off Argentina and Scotia Ridge from Tierra del Fuego to South Georgia	357–1244
<i>Stylaster profundus</i> (Moseley, 1879)	Off Argentina, South Georgia, southwestern Chile	631–1097

(Moseley, 1879), *Stylaster densicaulis* Moseley, 1879, and *Stylaster profundus* (Moseley, 1879) and the one from R/V *Vema* station 17-RD14 is *Cheiloporidion pulvinatum* Cairns, 1983. These species were also collected further south in the Subantarctic and Antarctic regions (see Table 1).

The Mar del Plata submarine canyon is a unique zone and poorly explored regarding its biodiversity. Around that latitude (about 38° S), the Brazil-Malvinas Confluence (BMC) occurs: the warm Brazilian current coming southward from the equatorial current meets the cool Malvinas current, which is the northern arm of the Circumpolar Antarctic Current, this confluence generating one of the highest energetic oceanic zones in the world (Piola and Matano 2001). The present research is relevant with regard to the particular conditions provided by the BMC and the fact that submarine canyons are known to be hotspots of benthic biomass and productivity (De Leo et al. 2010).

Errina Gray, 1835 is a genus of arborescent stylasterids that includes, discounting *Errina cyclopora* Cairns, 1983, 26 recent species distributed in the North Atlantic, Mediterranean Sea, Galápagos, South Africa, Antarctic and Subantarctic regions, New Zealand, New Caledonia, Japan, and Tristan da Cunha Archipelago at depths of 15–1772 m (Cairns 1986,

2015; Cairns and Zibrowius 1992; Pica et al. 2015). There are no described species of *Errina* from or near the study area, and *Errina antarctica* is so far the only species described from the SWA off Argentina altogether.

The aim of this work is to describe *Errina argentina* sp. nov. based on the examination of 16 colony fragments collected from the Mar del Plata submarine Canyon at 1398m depth.

Material and methods

Seventeen fragments of *Errina argentina* were collected during the “Talud Continental III” campaign in September 2013 in the Mar del Plata submarine canyon at station N° 59: 37° 49' 41" S, 54° 5' 14" W (1398m depth) using a trawling net. They were preserved in ethanol 96% or ethanol 70% and deposited in the Museo Argentino de Ciencias Naturales “Bernardino Rivadavia” (MACN), Buenos Aires, Argentina. Specimens of the genus *Errina* described in Cairns (1983) from Antarctic and Subantarctic regions and deposited at the Smithsonian National Museum of Natural History (NMNH),

Washington D.C., were re-examined and compared with the present material.

Specimens were studied under naked eye, with dissecting microscope and with scanning electron microscopy (SEM). A dissecting microscope was used to examine the types of pores present and their distribution pattern on the surface of the coenosteum. Fragments of branches seen in cross section were used in some cases to roughly determine the gastropore tube length and its shape, its position with regards to the branch axis (axial or peripheral), and the shape and length of the gastrostyles. The ampullae could also be seen in branch cross section.

Measurements of dactylopores and gastropores were done with an ocular micrometer on a dissecting microscope. Fifty dactylopore spines of five fragments and 99 gastropores of seven fragments were measured. Newly formed dactylopore spines from branch tips were chosen for the measurements since they are the largest that could be found in each specimen; those in more proximal positions are lower in height, older, and worn. Gastropores were measured in distal and proximal end of newly formed and older branches. Flush dactylopores were measured from SEM pictures using the ImageJ program (Schneider et al. 2012).

SEM was used to study the ultrastructure of coenosteal texture, pores, gastropore tubes and gastrostyles, dactylopore spines, and ampullae. Small fragments of coral branch were broken off and bleached with sodium hypochlorite for a few hours, then rinsed, dried, and placed on SEM stubs. In order to reveal the whole length of the gastropore tube and gastrostyle, a thin blade and air drill were used to pull off or wear down remaining coenosteum surrounding the gastropore tube. Gastrostyles from terminal and basal branches were measured using SEM pictures and ocular micrometer.

In order to study the nematocyst size and their distribution in the tissues, a small section of one fragment was studied using light microscopy (1000x magnification). A section of about 1 cm from a terminal branch of specimen MACN-In 40652 was cut and decalcified using Biopack decalcification solution. After complete decalcification, small fragments of coenosarc and nine gastrozooids were removed from the colony under dissecting microscope. Permanent preparations were made following Yanagi's (1999) technique (see Häussermann 2004 for details). Since it was not possible to separate dactylozooids from the coenosarc, nematocysts were not measured in that tissue. At least 15 non-fired capsules of each type (when possible) were photographed and measured using Zeiss Axiovision software. Mean and standard deviation is provided (when possible) to give an idea of size distribution and variability (large range \times wide range; large mean \pm standard deviation \times wide mean \pm standard deviation). Since most of the capsules were small (under 10 μm) and no fired capsules were found, identification of the nematocyst type (especially in the case of the isorhizas) is tentative, so results remain uncertain.

Authorship of new names here contained should be attributed to Bernal MC, Cairns SD, and Lauretta D.

Results

Phylum Cnidaria

Class Hydrozoa Owen, 1843

Order Anthoathecata Cornelius, 1992

Suborder Filifera Kühn, 1913

Family Stylanderidae Gray, 1847

Genus *Errina* Gray, 1835

Diagnosis: Modified from Cairns (2015) and Pica et al. (2015): Colonies uniplanar and usually bushy. Coenosteal texture normally reticulate-granular, but may be linear-imbricate; coenosteum often colored. Gastropores and dactylopores uniformly arranged. Gastropores may be bordered by a lower lip; gastrostyles present. Dactylopore spines horseshoe-shaped in cross section and adcauline (dactyloptome facing downward) in orientation. Dactylostyles usually absent (present in only one species). Ampullae superficial; female with lateral efferent pore.

Distribution: North Atlantic, Mediterranean Sea, Galápagos, South Africa, Antarctic and Subantarctic regions, New Zealand, New Caledonia, Japan, and Tristan da Cunha Archipelago, 15–1772 m. Paleocene of Denmark. New record from the SWA off Mar del Plata, 1398 m.

Type species: *Millepora aspera* Linnaeus, 1767, by monotypy

Listed species: Discounting *E. cyclopora*, 26 recent species and one extinct species (Cairns 2015; Pica et al. 2015).

Errina argentina: Bernal, Cairns & Lauretta sp. nov.

Zoobank ID: urn:lsid:zoobank.org:pub:B4731C3D-2D97-4E1B-88D6-C0FF648A19ED

Material examined: Holotype: MACN-In 41480, female, 1 fragment, approx. 300 km off Mar del Plata, Argentina St. N° 59 (37° 49' 41" S; 54° 5' 14" W), 1398 m, September 2013, preserved in 70% ethanol; female paratypes: MACN-In 40652, 15 fragments, same locality and date as holotype, preserved in 70 and 96% ethanol, and three SEM stubs (n° 31, 32, and 33).

Distribution: Known only from the type locality.

Description: Fragments of colonies are uniplanar in growth, with anastomosis in basal branches (Fig. 1a–c). In some cases, basal branches anastomose, producing two overlapping planes of growth (Fig. 1c). The holotype is a fragment 6.1 cm tall with maximum branch diameter of 0.8 \times 0.6 cm. Holotype and paratypes are broken at their bases, so actual basal branch diameter is unknown. Maximum branch diameter is 0.8 \times 1.0 cm in a paratype fragment. Branching is dichotomous and equal, with robust branches that grow vertically upwards and gradually taper towards blunt tips. Branches are round to slightly elliptical in cross section with the greater axis

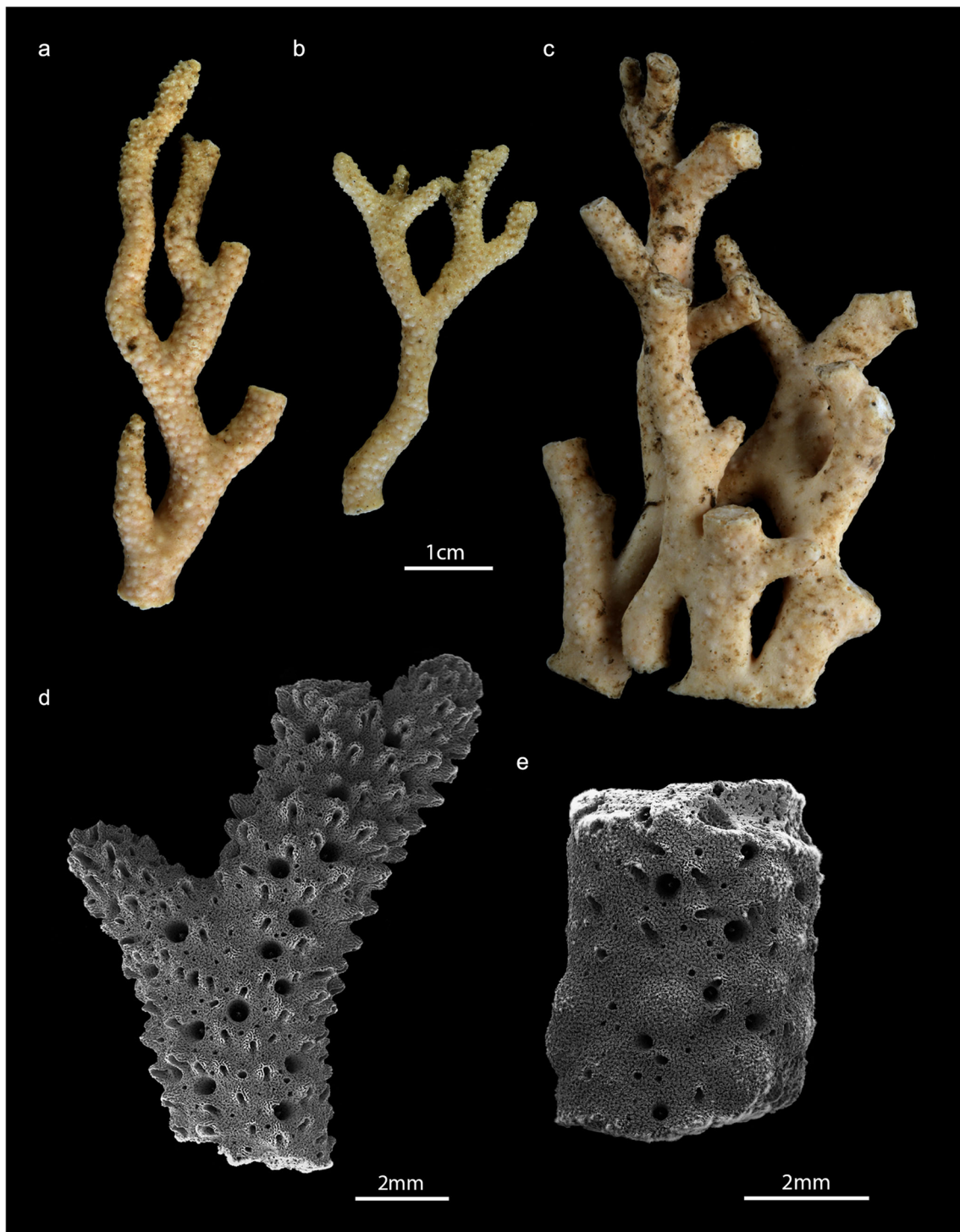


Fig. 1 **a** Holotype MACN-In 41480. **b** Terminal branches of a colony (paratype). **c** Anastomotic basal branches (paratype). **d** Gastropores and dactylopores on branch tip (paratype, fragment taken from branch tip illustrated in **b**). **e** Ampullae half sunken in branch coenosteum (paratype)

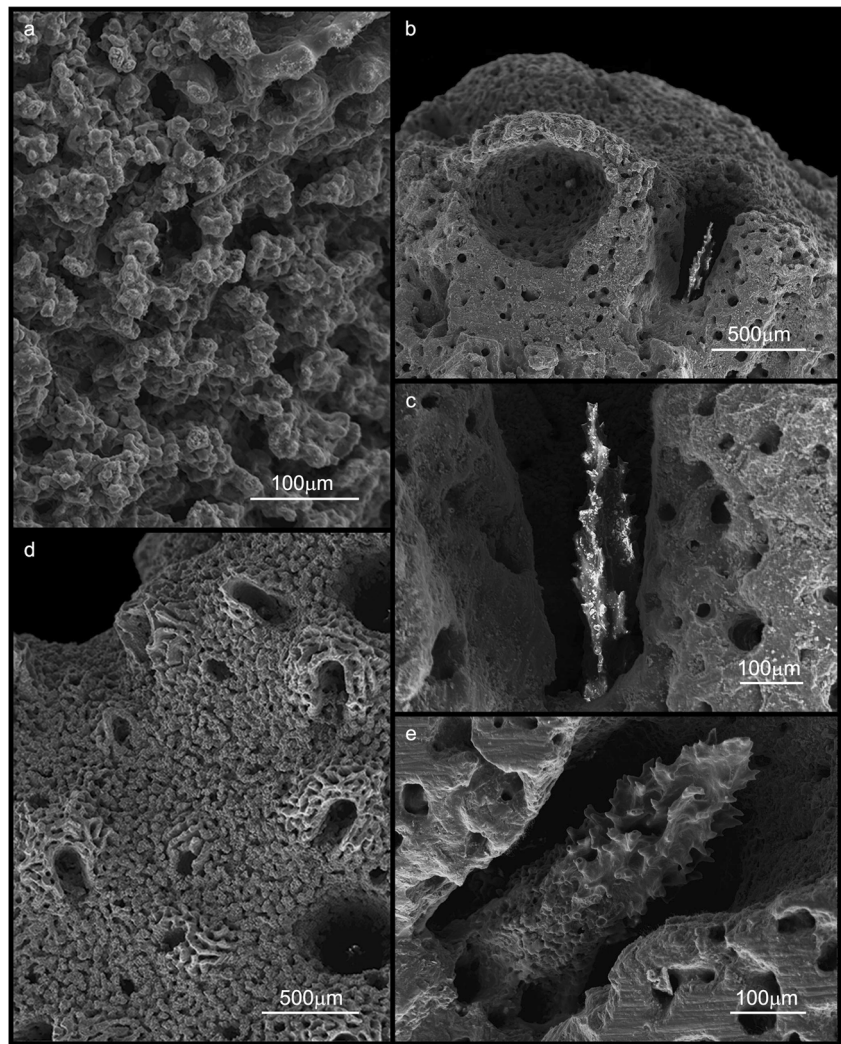
oriented in plane of fan. No lateral branchlets observed. High density of ampullae on main and terminal branches confers a bumpy appearance to branch surface.

The coenosteum is white, coarse, with a reticulate-granular texture (Fig. 2a). Coenosteal strips are irregular in shape and width, 23–52 μm wide, composed of irregularly shaped

granules fused with each other in variable-sized clusters. Coenosteal slits are short and irregular in width.

Gastropores and dactylopores are uniformly distributed on all branch surfaces, although there is a certain anterior-posterior orientation, with a higher density of both types of pores on anterior face as well as on branch tips with regard to

Fig. 2 Skeletal structures of paratypes seen with SEM. **a** Coenosteal texture. **b** Cross section of branch showing gastropore tube and adjacent ampulla. **c** Gastrostyle. **d** Adcauline dactyloporo spines and flush dactyloporo. **e** More robust gastrostyle



more proximal ends of branches (Fig. 1d, e). Basal branches have much lower density of pores than rest of colony.

Gastropores are round, flush with surface of coenosteum, with a diameter of 0.24–0.55 mm and an average of 0.39 mm ($\sigma = 0.07$, $N = 99$). Gastropores are smallest towards proximal end of older branches. A lip is absent. Gastropore tubes are peripheral, short, and cylindrical, lacking a ring palisade. Gastrostyles are spindle to needle-shaped, 0.43–0.48 mm high with an average of 0.47 mm ($N = 4$), occupying almost the entire gastropore tube length with the tip easily seen from the surface opening. Tabulae are absent. The illustrated gastrostyle (Fig. 2c) from halfway down a terminal branch is 0.48 mm high and 0.11 mm wide (H:W ratio = 4.36) and has longitudinal ridges, which bear short thick spines. Another more robust gastrostyle from the branch tip is illustrated (Fig. 2e), where more ridges are present and spines are thicker.

Dactyloporo occur in two kinds (Fig. 2d): those surrounded by an adcauline U-shaped dactyloporo spine and those flush with coenosteum. Dactylostyles are absent. Some dactyloporo may be oriented laterally. Spines range from

about 0.28 to 0.58 mm in height, with an average of 0.41 mm ($\sigma = 0.07$, $N = 50$). The highest spines are concentrated in branch tips (Fig. 1b, d) whereas those nearer proximal end of branches (Fig. 1c, e) are fewer, very low, and scattered, so that a colony lacking distal branches may seem to be deprived of them at first sight. Spines are 0.38–0.55 mm wide with an average of 0.49 mm ($\sigma = 0.05$, $N = 50$), and dactyloporo are 0.10–0.20 mm wide with an average of 0.15 mm ($\sigma = 0.02$, $N = 50$). The dactyloporo spines of the holotype range from 0.38 to 0.45 mm in width, slightly lower than dactyloporo spine width range of paratypes measured (0.43–0.55 mm). Some spines may have thicker walls than others, that is, the same total width but a different dactyloporo width. Flush dactyloporo are round and numerous, 0.07–0.13 mm in diameter. Coenosteum in dactyloporo spines is arranged in vertical strips perpendicular to branch surface, with the same granular texture as previously described.

Female ampullae hemispherical bulges on branch surface containing oocytes. Illustrated ampullae (Fig. 1e) are about 1 mm in external diameter. Ampulla seen in cross section in

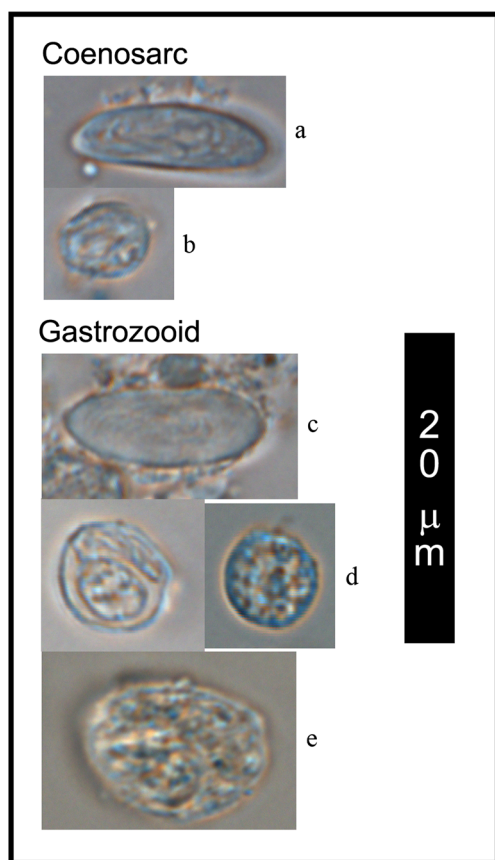


Fig. 3 Nematocysts found in coenosarc and gastrozooids. **a** Desmoneme from coenosarc, **b** Isorhiza from coenosarc. **c** Desmoneme 2 from gastrozoid. **d** Isorhizas from gastrozooids. **e** Eurytele from gastrozoid

Fig. 2b is about 0.8 mm in internal greater diameter. Male ampullae are not observed.

Nematocysts present in coenosarc and gastrozooids. Desmonemes? ($10.2\text{--}16.0 \times 3.5\text{--}4.9$; $13.9 \pm 1.3 \times 4.3 \pm 0.3$ $N=20$) and isorhizas? ($4.6\text{--}7.5 \times 4.6\text{--}6.5$; $5.9 \pm 0.9 \times 5.4 \pm 0.6$ $N=15$) were found in the coenosarc and desmoneme? 1 (15.1×3.1 $N=1$), desmonemes? 2 ($13.0\text{--}15.4 \times 4.9\text{--}5.5$ $N=3$), isorhizas? ($5.1\text{--}9.3 \times 4.9\text{--}6.4$; $6.8 \pm 1.4 \times 5.9 \pm 0.7$ $N=9$), and eurytele? (12.5×9.1 $N=1$) were found in the gastrozooids (Fig. 3). Dactylozooids are not observed.

Discussion

Our specimens clearly belong to the genus *Errina* due to the random arrangement of gastropores and dactylopores and the absence of cyclo systems, the presence of U-shaped adcauline dactylopores spines, the presence of a gastrostyle, and the presence of external ampullae. *Errina antarctica* was the only species of the genus so far described from the SWA in Argentine waters (Cairns 1983). It differs from *Errina argentina* in the following: (a) *E. antarctica* has an orange coenosteum whilst *E. argentina* has a white one, (b)

E. argentina has larger gastropores, (c) *E. antarctica* has higher dactylopores spines, and (d) flush dactylopores in *E. antarctica* are slit-like whilst those in *E. argentina* are round. *Errina argentina* is most similar to *E. kerguelensis* Broch, 1942 due to its general form of growth, thick branches with no lateral branchlets, similar arrangement of gastropores and dactylopores, and similar coenosteal texture. However, they differ in various aspects: (a) coenosteal strips are considerably wider in *E. kerguelensis*, (b) gastrostyles in *E. argentina* and *E. kerguelensis* differ in shape and ornamentation, (c) ampullae in *E. kerguelensis* are always internal whilst those in *E. argentina* are superficial, (d) the gastropore tube is not constricted in *E. argentina* whereas it is in *E. kerguelensis*, and (e) *E. argentina* has numerous flush dactylopores whilst *E. kerguelensis* has almost exclusively dactylopores surrounded by a U-shaped spine.

Studies on diversity of stylasterids from the SWA are scarce at the moment (Broch 1942, 1951; Cairns 1983; Gray 1872; Moseley 1876, 1879; Pica et al. 2015). Further studies are necessary to establish whether the species richness from south of the SWA is homogeneous throughout the Argentine Sea. The fact that all of the stylasterid species collected at station 320 by the *Challenger* expedition and *C. pulvinatum* at R/V *Vema* station 17-RD14 were also collected in the Subantarctic and Antarctic regions (Cairns 1983) suggests this homogeneity is quite probable. *Errina argentina* probably also has a more ample distribution than just the Mar del Plata submarine canyon. This could be confirmed with further sampling along the SWA.

Acknowledgements Many thanks to the crew of the O/V *Puerto Deseado* for their assistance and to Bert Hoeksema and the reviewers of this paper for their suggestions.

Funding information This work was supported by PICT 2013-2504 grants to Dr. Pablo Penchaszadeh, a PADI Foundation grant to Dr. Daniel Lauretta, and a PADI Foundation grant to Carolina Bernal.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All applicable international, national, and/or institutional guidelines for the care and use of animals were followed by the authors.

Sampling and field studies All necessary permits for sampling and observational field studies have been obtained by the authors from the competent authorities.

References

- Braga-Henriques A, Carreiro-Silva M, Porteiro FM, de Matos V, Sampaio I, Ocaña O, Avila SP (2010) The association between a deep-sea

- gastropod *Pedicularia sicula* and its coral host *Errina dabneyi* in the Azores. ICES J Mar Sci 68:399–407. <https://doi.org/10.1093/icesjms/fsq066>
- Broch H (1942) Investigations on Stylasteridae (Hydrocorals). Skr utgitt av Del Norske Vidensk-Akad I Oslo, I: Mat-Naturv Klasse 3:1–113
- Broch H (1951) Stylasteridae (Hydrocorals) from the Southern Seas. Discov Rep 26:33–46
- Cairns SD (1983) Antarctic and Subantarctic Stylasterina (Coelenterata: Hydrozoa). Biol Antarctic Seas XIII. Antarctic Res Ser 38:61–164
- Cairns SD (1986) A revision of the Northwest Atlantic Stylasteridae (Coelenterata: Hydrozoa). Smithson Contrib Zool 418:1–131
- Cairns SD (1991) The marine fauna of New Zealand, Stylasteridae (Cnidaria, Hydrozoa). NZ Oceanogr Inst Mem 98:1–179
- Cairns SD (2015) Stylasteridae (Cnidaria: Hydrozoa: Anthoathecata) of the New Caledonian region. Mém Mus Natl Hist Nat 207:1–362
- Cairns SD (2017) New species of stylasterid (Cnidaria: Hydrozoa: Anthoathecata: Stylasteridae) from the Northwestern Hawaiian Islands. Pac Sci 71:77–81
- Cairns SD, Zibrowius H (1992) Revision of the northeast Atlantic and Mediterranean Stylasteridae (Cnidaria: Hydrozoa). Mém Mus Natl Hist Nat 153:1–136
- Cornelius PFS (1992) Medusa loss in leptoid Hydrozoa (Cnidaria), hydroid rafting, and abbreviated life-cycles among their remote-island faunas: an interim review. Aspects of hydrozoan biology. Sci Mar 56:245–261
- De Leo FC, Smith CR, Rowden AA, Bowden DA, Clark MR (2010) Submarine canyons: hotspots of benthic biomass and productivity in the deep sea. Proc R Soc B 277:2783–2792
- Di Camillo CG, Bavestrello G, Cerrano C, Gravili C, Piraino S, Puce S, Boero F (2017) Hydroids (Cnidaria, Hydrozoa): a neglected component of animal forests. In: Rossi S, Bramanti L, Gori A, Orejas C (eds) Marine animal forests. Springer, Cham, pp 397–427. https://doi.org/10.1007/978-3-319-21012-4_11
- Goud J, Hoeksema BW (2001) *Pedicularia vanderlandi* spec. nov., a symbiotic snail (Caenogastropoda: Ovulidae) on the hydrocoral *Distichopora vervoortii* Cairns and Hoeksema, 1998 (Hydrozoa: Stylasteridae), from Bali, Indonesia. Zool Verh 334:77–97
- Gray JE (1835) Characters of two new genera of corals, *Errina* and *Anthopora*. Proc Zool Soc Lond 1835:85–86
- Gray JE (1847) An outline of the arrangement of stony corals. Ann Mag Nat Hist 1(29):120–128
- Gray JE (1872) *Thouarella antarctica*, from the Falkland Islands. Ann Mag Nat Hist 4(9):482
- Häussermann V (2004) Identification and taxonomy of soft-bodied hexacorals exemplified by Chilean sea anemones; including guidelines for sampling, preservation and examination. J Mar Biol Ass UK 84:931–936
- Kühn A (1913) Entwicklungsgeschichte und Verwandtschaftsbeziehungen der Hydrozoen. I. Teil: Die Hydroiden. Erg Fortschr Zool 4:1–284
- Moseley HN (1876) Preliminary note on the structure of the Stylasteridae, a group of stony corals which, like the Milleporidae, are hydroids, and not anthozoans. Proc R Soc Lond 25:93–101
- Moseley HN (1879 (1878)) On the structure of the Stylasteridae, a family of the hydroid stony corals. Phil Trans R Soc Lond 169:425–503
- Owen R (1843) Lectures on the comparative anatomy and physiology of the invertebrate animals. Longman, Brown, Green & Longmans, London
- Pica D, Bertolino M, Calcinaï B, Puce S, Bavestrello G (2012) Boring and cryptic sponges in stylasterids (Cnidaria: Hydrozoa). Ital J Zool 79:266–272. <https://doi.org/10.1080/11250003.2011.632384>
- Pica D, Cairns SD, Puce S, Newman WA (2015) Southern hemisphere deep-water stylasterid corals including a new species, *Errina labrosa* sp. n. (Cnidaria, Hydrozoa, Stylasteridae), with notes on some symbiotic scalpellids (Cirripedia, Thoracica, Scalpellidae). ZooKeys 472:1–25. <https://doi.org/10.3897/zookeys.472.8547>
- Pica D, Tribollet A, Golubic S, Bo M, Di Camillo CG, Bavestrello G, Puce S (2016) Microboring organisms in living stylasterid corals (Cnidaria, hydrozoa). Mar Biol Res 12:573–582
- Piolo AR, Matano RP (2001) Brazil and Falklands (Malvinas) currents. In: John HS (ed) Encyclopedia of ocean sciences. Academic Press, London, pp 340–349. <https://doi.org/10.1006/rwos.2001.0358>
- Puce S, Tazioli S, Bavestrello G (2009) First evidence of a specific association between a stylasterid coral (Cnidaria: Hydrozoa: Stylasteridae) and a boring cyanobacterium. Coral Reefs 28:177. <https://doi.org/10.1007/s00338-008-0411-6>
- Schneider CA, Rasband WS, Eliceiri KW (2012) NIH image to ImageJ: 25 years of image analysis. Nat Methods 9:671–675
- Studer T (1878) Übersicht der Steinkorallen aus der Familie der Madreporaria aporosa, Eupsammina und Turbinarina, welche auf der Reise S.M.S. Gazelle um die Erde gesammelt wurden. Monat Akad Wiss Berlin 1877:625–655
- Tribollet A, Pica D, Puce S, Radtke G, Campbell SE, Golubic S (2017) Euendolithic *Conchocelis* stage (Bangiales, Rhodophyta) in the skeletons of live stylasterid reef corals. Mar Biodivers:1–8. <https://doi.org/10.1007/s12526-017-0684-5>
- Wisshak M, López Correa M, Zibrowius H, Jakobsen J, Freiwald A (2009) Skeletal reorganization affects geochemical signals, exemplified in the stylasterid hydrocoral *Errina dabneyi* (Azores Archipelago). Mar Ecol Prog Ser 397:197–208
- Yanagi K (1999) Taxonomy and developmental biology of Japanese *Anthopleura* (Anthozoa: Actiniaria). Doctoral thesis, Tokyo University of Fisheries, Tokyo, Japan
- Zibrowius H (1981) Associations of Hydrocorallia Stylasterina with gall-inhabiting Copepoda Siphonostomatoidea from the south-west Pacific. Part 1. On the stylasterine hosts, including two new species. Bijdr Dierk 51:268–286