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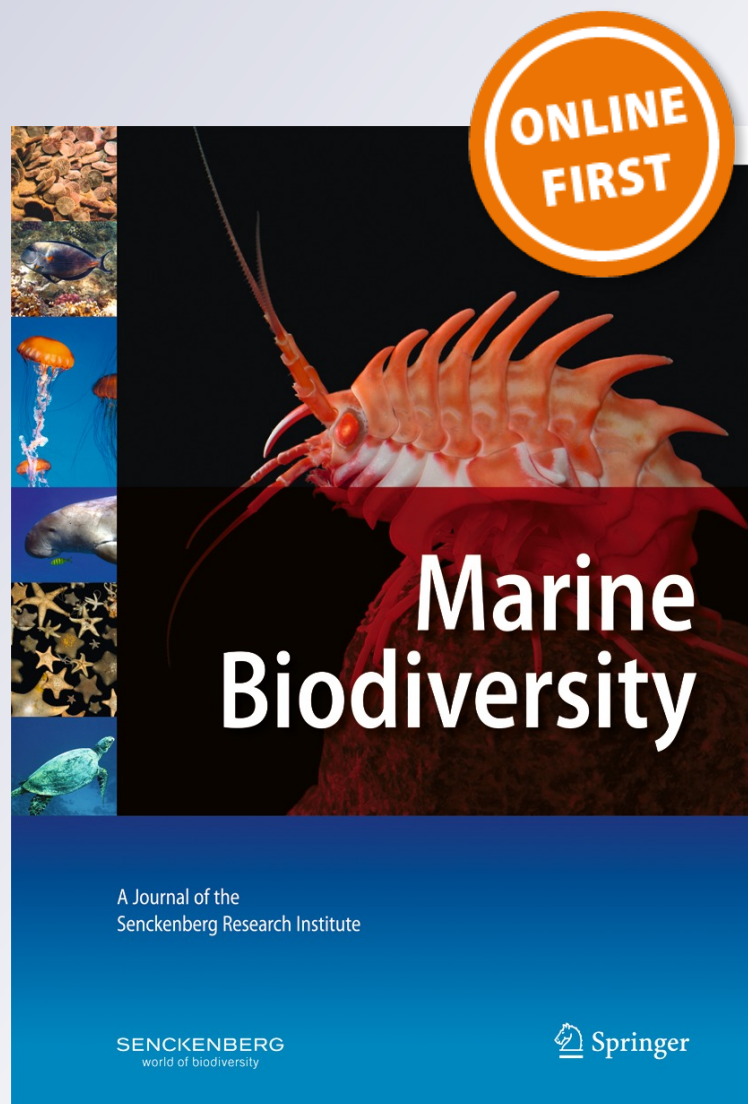
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Recent discovery of non-indigenous bryozoans in the fouling assemblage of Quequén Harbour (Argentina, Southwest Atlantic)

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Abstract The non-indigenous bryozoans *Aspidelectra melolontha* (Landsborough) and *Amathia verticillata* (Delle Chiaje) (= *Zoobotryon verticillatum*) are recorded for the first time in Argentina. They were found on experimental substrata submerged to study the fouling assemblage of Quequén Harbour (38°34.310'S, 58°42.814'W), an estuarine environment. *Biflustra puelcha* (d'Orbigny) comb. nov., *Conopeum reticulum* (Linnaeus), *Conopeum seurati* (Canu), *Cryptosula pallasiana* (Moll), *Electra monostachys* (Busk) and *Schizoporella cf. errata* (Waters) were also found in this association. *Aspidelectra melolontha*, a species native to Europe with only one record for San Francisco Bay (United States) based on unpublished data, is here reported for the first time for South America, and the affinity between this species and *A. zhoushanica* (Wang) is discussed. The presence of *C. seurati* in brackish water habitats of Argentina is confirmed. *B. puelcha* was previously unknown as a fouler in harbours. *A. verticillata* is a well-known marine fouler in many harbours and marinas worldwide. The southernmost record of this species on the Atlantic coast of South America was in Brazil. Thus, its distribution is herein expanded by 14° of latitude towards the south. In view of its great invasive potential, *A. verticillata* seems to have the ability to continue its dispersal and to become a stable component of this and neighbouring harbours.

Keywords Introduced species · Bryozoa · *Amathia verticillata* · *Aspidelectra melolontha* · *Conopeum seurati*

Introduction

Ports have proven to be important centres for the introduction of non-indigenous species (Carlton 2010; Occhipinti-Ambrogi et al. 2011). Therefore, it is not unusual to find exotic bryozoans attached to hard surfaces in harbours (Hewitt et al. 2004; Castilla et al. 2005; Mackie et al. 2006; Gordon et al. 2008; Louis and Menon 2009; Ryland et al. 2011; Kelso and Wyse Jackson 2012; Rosso in Thessalou-Legaki et al. 2012), marinas (Ryland et al. 2011, 2014; Marchini et al. 2015) and neighbouring areas (Koçak 2007) throughout the world.

Quequén Harbour, located at the mouth of the Quequén Grande estuary (Fig. 1), is an important overseas terminal and the second largest deepwater system in Argentina (Perillo et al. 2005). Mean water temperatures recorded at a neighbouring site within the estuary (Necochea Power Station) range from 10 °C (July) to 21 °C (February), while absolute minimum and maximum values may reach 8.9 and 22 °C, respectively (Brankevich et al. 1985). Large salinity fluctuations related to the tidal cycle are common in this harbour. Mean values range from 6 to 27 PSU, while extreme salinity values may reach 4 and 32 PSU (Brankevich et al. 1985). pH values between 8 and 8.3 have been recorded in the water column (Brankevich et al. 1985), but reduced sediments may predominate in certain areas of the harbour due to wind-blown grains that settle at the bottom during ship loading (Perillo et al. 2005).

More than 25 exotic, cryptogenic and native bryozoan species have been found in different marine harbours of Argentina (Lichtschein de Bastida and Bastida 1980; Orensanz et al. 2002; Schwindt et al. 2014; López-Gappa and Liuzzi 2016). In comparison with other harbours in the area, Quequén was thought to be characterized by relatively

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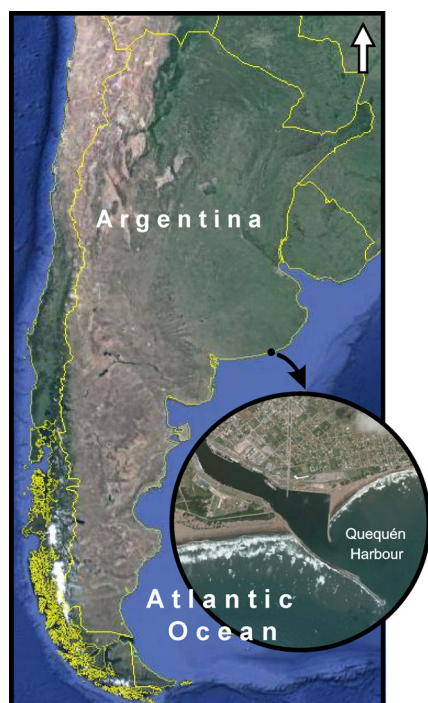


Fig. 1 Study area

low bryozoan diversity, probably due to its estuarine features. Two species were previously recorded during a detailed taxonomic study of its bryozoan assemblages: *Cryptosula pallasiana* (Moll) and *Conopeum* sp. (Lichtschein de Bastida and Bastida 1980). Four other bryozoans have also been listed for Quequén Harbour in the ecological literature, but their presence is not yet confirmed by taxonomic studies, scanning electron microscope (SEM) images or voucher specimens deposited in museum collections: *Bugulina flabellata* (Thompson) (Brankevich et al. 1984, 1985, as *Bugula flabellata*), *Bugula neritina* (Linné) (Albano 2012), *Amathia* sp. (Brankevich et al. 1986, as *Bowerbankia* sp.) and *Conopeum reticulum* (Linné) (Brankevich et al. 1988). An abundant population of the non-indigenous microporellid *Fenestrulina delicia* Winston, Hayward and Craig was recently recorded on the same artificial experimental substrates as those in the present study (López-Gappa and Liuzzi 2016).

The main aim of this study is (1) to describe the bryozoan fauna of Quequén Harbour (Argentina, Southwest Atlantic), (2) to report the presence of non-indigenous species, and (3) to discuss their potential to continue their dispersal and become stable components of the fouling assemblages of this and neighbouring harbours.

Material and methods

Bryozoans were found on 48 rectangular (210 × 260 × 3.5 mm) low-density polyethylene panels fastened to vertical supporting structures suspended 2 m below spring low-water level from a

pier at Quequén Harbour (“Bita 49”, 38°34.310’S, 58°42.814’W) on September 20, 2012 (late winter). The only colony of *A. verticillata* was collected on March 20, 2013, on the supporting structures. The experimental layout was inspected for maintenance at quarterly intervals (late spring: December 2012, late summer: March 2013). The panels were eventually collected on June 21, 2013 (winter), and thoroughly examined for attached colonies in the laboratory.

Part of the material was cleaned in diluted domestic bleach (NaOCl solution) and coated with gold–palladium (40/60 %). Digital images were obtained using a conventional SEM (Philips XL–30) at the Museo Argentino de Ciencias Naturales (MACN). One or a few colonies of each species were deposited as voucher samples in the collection of invertebrates of MACN (MACN-In).

The synonymic lists are not exhaustive; only the original descriptions and the most relevant re-descriptions were included, mainly from harbour environments.

Results

Amathia verticillata (Delle Chiaje, 1828)

Hydra verticillata Delle Chiaje, 1828: 203, [1822] pl. 47, figs. 1, 2.

Zoobotryon pellucidum: Marcus (1937): 139, pl. 28, fig. 75A, B.

Zoobotryon verticillatum: Gordon and Mawatari (1992): 14, fig. 2F; Winston (1995): 88, figs. 1B, 2; Abdel-Salam and Ramadan (2008a): 35–37, fig. 3; Amat and Tempera (2009): 761–764, fig. 1a, b; Farrapeira (2011): 13–16; Minchin (2012): 2146–2150, figs. 1, 2; Galil and Gevili (2014): 1, figs. 1, 2; Vieira et al. (2014): 518, figs. 98–101.

Amathia verticillata: Waeschenbach et al. (2015): 678; Marchini et al. (2015): 355–362, fig. 2.

Description The morphological features of our specimen agree with those described by Gordon and Mawatari (1992).

Remarks One ramifying colony was collected on the panels during late summer. Embryos were present within some zooids. This ctenostome bryozoan, formerly known as *Zoobotryon verticillatum*, was recently transferred to the genus *Amathia* based on the results of a molecular phylogenetic study (Waeschenbach et al. 2015).

Voucher material of this species was deposited at MACN (no. 40307).

Distribution: *Amathia verticillata* is a well-known invasive species that may develop luxuriant populations in many ports and marinas worldwide (e.g. Amat and Tempera 2009; Farrapeira 2011; Minchin 2012; Ferrario et al. 2014). It is commonly found from the intertidal to about 10 m depth (Vieira et al. 2014). Until recently, *A. verticillata* was perceived as being native to the Mediterranean, but Winston (1995), and later Galil and Gevili (2014), suggested that the

species was native to the Caribbean Sea. The southernmost record in South America was Santos (São Paulo state, Brazil) (Marcus 1937, as *Zoobotryon pellucidum*). Thus, we extend its southernmost distribution limit by 14° of latitude along the Atlantic coast of South America. Quequén Harbour (this study) and Port Phillip Bay, Australia (38°09'S-144°52'E, Hewitt et al. 2004), are the world's southernmost records of *A. verticillata*.

Biflustra puelcha (d'Orbigny, 1847) comb. nov.

Fig. 2a–b

Flustra puelcha d'Orbigny, 1847: 18, [1842]: pl. 8, figs. 15, 16.

Membranipora puelcha: López Gappa (1982): 60, figs. 1, 2; López Gappa and Lichtschein (1990): 9, pl. 2, fig. 1.

Description Colony encrusting, unilaminar. Autozooids longer than wide, $0.42\text{--}0.51 \times 0.31\text{--}0.37$ mm, clearly limited by sutures. Opesia subcircular to oval, occupying 75 to 85 % of zooidal length. Cryptocyst tuberculated, well-developed in the proximal part of the zooid, but vestigial laterally and distally. Spines pointed, varying in number and size, originating from the proximal and lateral margins of the cryptocyst, directed towards the opesia, often asymmetrical and bended basally. One or two blunt tubercles on the proximo-lateral corners of the zooid, sometimes absent. Basal wall granular. Ovicells and avicularia absent. Ancestrula twinned. A distomedial zooid is budded as a wedge between the twinned ancestrula (Fig. 2b), then the early astogeny proceeds laterally and proximally so as to form a circular colony.

Remarks Fully grown colonies were rare on the panels. Reproduction was occurring in June, since only a few recently recruited colonies were observed. *Biflustra puelcha* can be clearly distinguished from coexisting species of *Electra* and

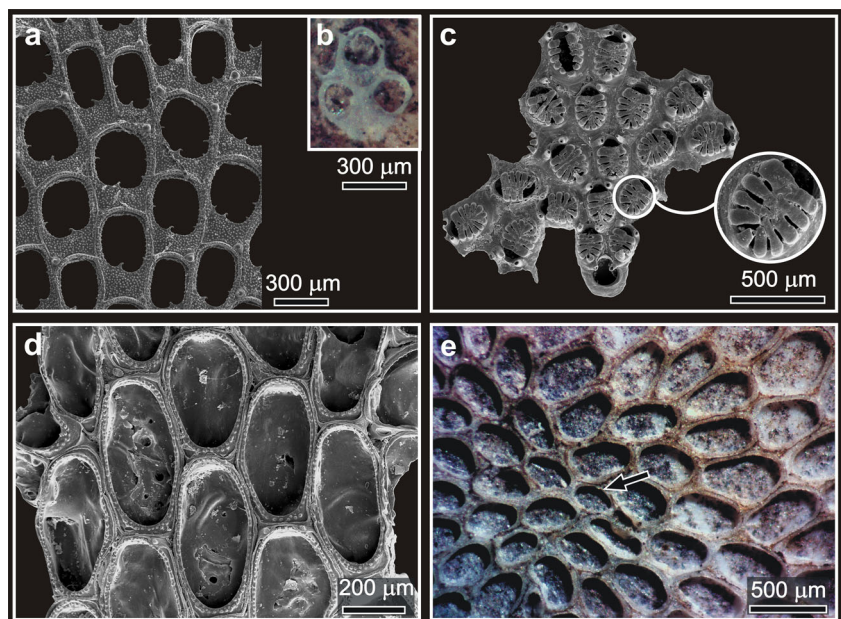
Conopeum by its twinned ancestrula (Fig. 2b) and because the spines around the opesia arise from the cryptocystal margin.

Although the early astogeny of *B. ramosa* d'Orbigny, 1852, the type species of *Biflustra* d'Orbigny, 1852, is unknown, *Flustra puelcha* is here transferred to d'Orbigny's genus based on its zooidal features.

The type locality of *B. puelcha* is San Blas Bay (d'Orbigny 1847) (40°33'08"S, 62°14'04"W). The species was redescribed 135 years after its original description, based on specimens found very close to its type locality (López Gappa 1982). This material was growing on the hydroid *Amphisbetia operculata* (Linnaeus), probably the same substrate associated with the colonies found by d'Orbigny. This identification was later confirmed by one of us (JLG) by comparison with the type of *Flustra puelcha* deposited in the Musée National d'Histoire Naturelle (d'Orbigny Collection no. 13703) (see López Gappa and Lichtschein 1990). Its characteristic features are the inconstant presence of one or two blunt tubercles in the proximo-lateral corners of the autozooid and calcareous spines arising from the cryptocyst and extending towards the interior of the opesia. The morphology of this species falls within the range of variation of *Biflustra tenuis* (Desor), described for the Atlantic coast of the United States 1 year after the original description of *B. puelcha* (see Desor 1848). The known geographic distribution of *B. tenuis* ranges from the western North Atlantic to Brazil (Winston and Hayward 2012). *B. puelcha* and *B. tenuis* are probably the same species reaching its southern distribution limit in northern Patagonia. To confirm this assumption, however, a comparison of topotypic material of the two nominal species will be necessary.

Voucher material of this species was deposited at MACN (no. 40308).

Fig. 2 *Biflustra puelcha*. **a** General aspect of a colony. **b** Twinned ancestrula and first zooid. *Aspidelectra melolontha*. **c** Young colony showing ancestrula and early astogeny; the inset shows a detail of the costae. *Conopeum seurati*. **d** General aspect. **e** Ancestrula (arrow) and early astogeny



Distribution Until the synonymy between *B. puelcha* and *B. tenuis* can be settled, the distribution of *B. puelcha* is restricted from Monte Hermoso (Buenos Aires Province) to the entrance of San Matías Gulf, northern Patagonia, Argentina, at depths between 0 and 65 m.

Aspidelectra melolontha (Landsborough, 1852)

Fig. 2c

Lepralia melolontha Landsborough, 1852: 319, pl. 18, fig. 70.

Membranipora melolontha: Prenant and Bobin (1966): 573, fig. 198.

Aspidelectra melolontha: Hayward and Ryland (1998): 138, fig. 31; De Blauwe (2009): 182, figs. 164, 165.

Description Colony encrusting, unilaminar, initially fan-shaped. Autozooids longer than wide, $0.28\text{--}0.41 \times 0.20\text{--}0.28$ mm, bordered by sutures. One pair of erect oral spines arising from the gymnocyst of the distally succeeding autozooid. Opposing series of costae fusing along the midline, leaving spaces between each other, ranging from four to six at each side, with the exception of the pair of zooids budding from the ancestrula that have three to four. The most distal pair of costae ending in two or three points; some of the other costae may also have bifurcated extremes. A third erect spine located medially and proximally present in almost half of the zooids. The remaining zooids sometimes with an additional small proximal costa replacing the spine. Ancestrula with an unprotected frontal membrane and one pair of erect oral spines, budding one pair of disto-lateral zooids already possessing the cribriform shield characteristic of the species.

Remarks The discovery of only one colony of *A. melolontha* in its early astogeny suggests that an abundant and permanent population has not yet been established in Quequén Harbour. The comparison of our colony with European material (see SEM images in Kittelmann and Harder 2005; De Blauwe 2009) shows almost identical morphological features, except for the number of costae, which is slightly lower in Quequén (3–6 vs. 5–8). De Blauwe (2009), however, shows a colony that attained its phase of astogenetic repetition, and it is well known that the number of costae increases with astogenetic development (cf. Figs. 31A and C in Hayward and Ryland 1998). Most of the drawings of European material (Busk 1854; Hincks 1880; Marcus 1940; Prenant and Bobin 1966; Hayward and Ryland 1998) depict costae with undivided extremes, but SEM images (e.g. De Blauwe 2009) show that they may be bifurcated, as in our material.

The original description of *Membraniporella aragoi zhoushanica* consisted of a very brief diagnosis and a poor illustration (Wang 1989). Liu et al. (2001) later renamed this Chinese species *Aspidelectra orientalis*, without noting that the name introduced by Wang (1989) was valid (see Gordon et al. 2008). A comparison of our colony with the illustrations of the Chinese (Liu et al. 2001) and New Zealand material

(Gordon et al. 2008) shows almost no difference except for the slightly longer proximal spines in the Chinese specimens. In view of the morphological similarity, we suspect that *A. melolontha* and *A. zhoushanica* may in fact be the same species thriving in brackish waters, and transported by man from one continent to another. The synonymy of *A. zhoushanica* with *A. melolontha*, however, should be confirmed by a comparison of type materials. Since the species lacks ovicells, embryos are probably brooded internally (Hayward and Ryland 1998). The larva of *A. zhoushanica* is unknown. The only colony found in New Zealand was attached to the hull of a recreational vessel (Gordon et al. 2008).

Voucher material of this species was deposited at MACN (no. 40309).

Distribution The type locality of *A. melolontha* is the Thames estuary, England (Landsborough 1852; Busk 1854). The species is native to Europe (Hayward and Ryland 1998; De Blauwe 2009), and is here reported for the first time from South America. The Atlantic coasts of Europe should be regarded as the original distribution area of *A. melolontha*, as it was found in subfossil deposits in the North Sea (Krüger 1999). Outside its native distribution area, there is only one record of *A. melolontha* for the San Francisco estuary (Pacific coast of the United States), where it was identified as *Aspidelectra* sp. by Cohen and Carlton (1995) (<http://invasions.si.edu/nemesis/calnemo/SpeciesSummary.jsp?TSN=-497>, accessed December 2015). In Europe, *A. melolontha* is common in estuaries. It occurs mainly on shells, in shallow water. *A. zhoushanica* has been found only in China and Auckland Harbour, New Zealand (Liu et al. 2001; Gordon et al. 2008).

Conopeum seurati (Canu, 1928)

Fig. 2d, e

Nitscheina seurati Canu, 1928: 263, figs. 3–6.

Conopeum seurati: Gordon and Mawatari (1992): 17, pl. 2B, C, pl. 4A. Hayward and Ryland (1998): 124, figs. 24C, D, 25; De Blauwe (2009): 172, figs. 150–152.

Description Colony encrusting, unilaminar. Autozooids weakly calcified, longer than wide, $0.42\text{--}0.53 \times 0.25\text{--}0.30$ mm, delimited by grooves. Gymnocyst reduced to small triangular laminae in the proximal corner of the autozooid. Cryptocyst granular, very slender. A single small pair of spines at the distal end of some zooids, frequently absent. Lateral marginal spines absent. Multiporous septula present in vertical walls. Kenozooids may occur in disrupted areas of the colony. Ovicells and avicularia absent. Ancestrula smaller than autozooids, producing a single distal bud (Fig. 2e). The astogeny then proceeds laterally and proximally so as to form a circular colony.

Remarks We found few fully-grown colonies of this species. It differs from *C. reticulum* by the lack of the characteristic triangular or fused kenozooids. The distal pair of small oral spines is frequently present in *C. seurati*, but we did not

see lateral spines around the opesia. The gymnocyst and cryptocyst are much more reduced in *C. seurati* than in *C. reticulum*.

Conopeum seurati is known to be associated with the non-indigenous reef-building serpulid polychaete *Ficopomatus enigmaticus* in the Mar Chiquita coastal lagoon (Schwindt and Iribarne 2000; Obenat et al. 2003). The examination of material from this locality confirms its presence in estuarine habitats of Buenos Aires Province.

Voucher material of this species was deposited at MACN (no. 40311). Material from Mar Chiquita coastal lagoon (no. 40312) was growing on *F. enigmaticus* and was collected by S. Obenat.

Distribution Atlantic coasts of Europe, Mediterranean Sea, Caspian Sea, Sea of Azov, New Zealand and Australia. The species is common in brackish lagoons and estuarine habitats (Gordon and Mawatari 1992; Hayward and Ryland 1998; De Blauwe 2009; Floerl et al. 2009a).

Conopeum reticulum (Linnaeus, 1767)

Fig. 3a

Millepora reticulum Linnaeus, 1767: 1284.

Conopeum reticulum: Ryland (1965): 30, fig. 13; Lichtschein de Bastida and Bastida (1980): 379, figs. 3, 14–16; Hayward and Ryland (1998): 120, figs. 23, 24A, B; Abdel-Salam and Ramadan (2008b): 6, fig. 2; De Blauwe (2009): 170, figs. 146–149.

Description Colony encrusting, uni- or multilaminar, whitish. Autozooids sub-rectangular, longer than wide, 0.51–0.57 × 0.20–0.30 mm, delimited by sutures. Opesia elliptical or oval. Lateral walls strongly calcified. Gymnocyst vestigial, barely visible on the proximo-lateral corners of the autozooid. Cryptocyst tuberculated, strongly developed proximally, occupying almost one sixth of the zooidal length. A variable

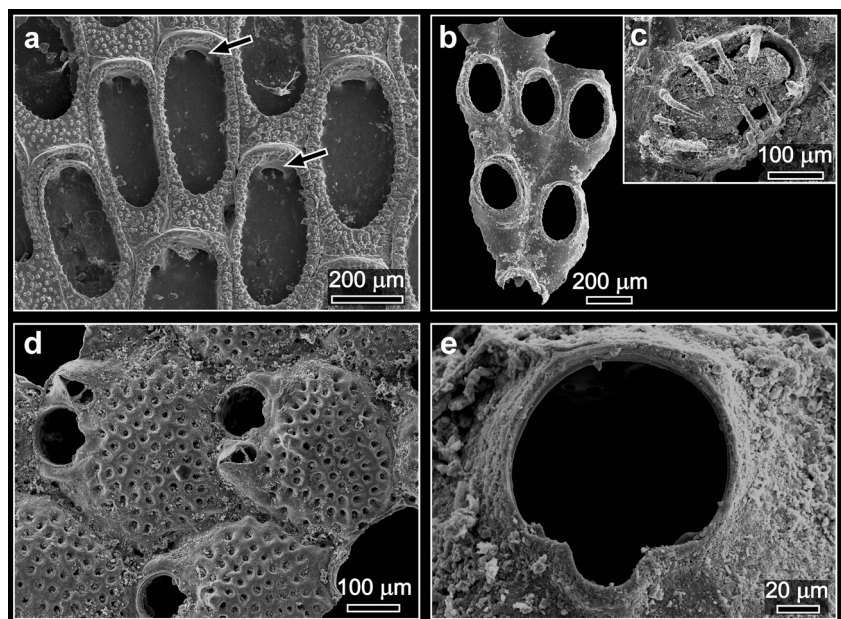
number of delicate spines may be present around the opesia. A single, large septulum buttressed by thickened calcification present in the terminal wall. A pair of triangular kenozooids with small rounded opesia may be present at the proximo-lateral corners of each zooid. The kenozooids may coalesce in the midline, or may be completely absent from most colonies. Ovicells and avicularia absent. Ancestrula single, smaller than the autozooids, budding mainly distally and proximally so as to produce a double fan-shaped colony.

Remarks Thousands of colonies of *C. reticulum* per square meter were found on all panels. Reproduction was occurring in June, since many recently recruited colonies consisting of the ancestrula plus a few zooids were observed. The triangular or fused kenozooids of *C. reticulum* are common in colonies from Mar del Plata harbour (Lichtschein de Bastida and Bastida 1980), but were extremely rare in those of Quequén. Reciprocal transplants between the two harbours might be useful for testing whether this feature is related to environmental factors such as differences in salinity. In the absence of kenozooids, *C. reticulum* can still be distinguished from *C. seurati* by the greater proximal development of the tuberculated cryptocyst and by the presence of one large septulum buttressed by thickened vertical calcification in its terminal wall (Fig. 3a), a feature that is absent in *C. seurati* (Fig. 2d). In addition, unbleached colonies of *C. reticulum* may have a variable number of small spines arched over the frontal membrane.

Voucher material of this species was deposited at MACN (no. 40310).

Distribution As a result of taxonomic confusion, the precise geographic range of *C. reticulum* is not known. It occurs on the Atlantic coasts of Europe, the western Mediterranean, and the archipelagos of Azores, Cabo Verde and the Canary

Fig. 3 *Conopeum reticulum*. **a** Several zooids. The arrows show the large septulum buttressed by thickened vertical calcification in the terminal wall. *Electra monostachys*. **b** Zooids cleaned with NaOCl, showing spine bases. **c** Uncleaned zooid showing spines curved over the frontal membrane. *Schizoporella* cf. *errata*. **d** Autozooids and avicularia. **e** Detail of orifice showing sinus and condyles



Islands, from the lower shore into the shallow sublittoral (Ryland 1965; Hayward and Ryland 1998; Abdel-Salam and Ramadan 2008b; De Blauwe 2009). It has also been found along the coasts of Brazil from Espírito Santo to Santa Catarina (Vieira et al. 2008 and references therein). Its known distribution in Argentina includes euhaline and estuarine harbours in Buenos Aires Province (Lichtschein de Bastida and Bastida 1980, this study) and Puerto Deseado (Santa Cruz Province, Patagonia) (López Gappa et al. 1982; Schwindt et al. 2014).

Electra monostachys (Busk, 1854)

Fig. 3b–c

Membranipora monostachys Busk, 1854: 61.

Electra monostachys: Ryland (1965): 27, fig. 11; Hayward and Ryland (1998): 134, fig. 29.

Description Colony encrusting, irregularly branching. Zooids longer than wide, narrowed proximally, $0.43\text{--}0.55 \times 0.22\text{--}0.28$ mm. Gymnocyst convex, smooth, constituting from one third to almost one half of the frontal surface. Cryptocyst granular, reduced to a hardly discernible rim around of the proximal and middle parts of the oval opesia. Spines pointed, variable in number, the most distal pair erect, the remaining ones curved over the frontal membrane, frequently absent. A median, proximal and stouter spine is constantly present. Communication pores opening near the basal zooidal surface. Ovicells and avicularia absent.

Remarks Hundreds of colonies of this species per square meter were found on the panels. Several ancestrulae and colonies in early astogeny were found, suggesting that the population was reproducing in June. It can be distinguished from *B. puelcha*, *C. reticulum* and *C. seurati* because the proximal gymnocyst encompasses one third or more of the frontal surface, and also by the presence of a stout erect proximal spine. In Great Britain it is also frequently found in association with *C. reticulum*, *C. seurati* and *A. melolontha* (Hayward and Ryland 1998). The colonies found in Quequén Harbour were usually dendritic.

Voucher material of this species was deposited at MACN (no. 40313).

Distribution: *Electra monostachys* is a well-known fouler in euhaline and brackish environments, mainly in lagoonal, estuarine and coastal habitats (Hayward and Ryland 1998). Its distribution includes both coasts of the North Atlantic, and the Mediterranean (Ryland 1965). It had already been recorded for three localities in Argentina (López Gappa et al. 1982; Roux et al. 1988; Bremec 1989; López Gappa 1989), but not within harbours. An unidentified species of *Electra*, probably *E. monostachys*, was found in the harbours of Río Gallegos and Ushuaia (Argentina) (Schwindt et al. 2014).

Schizoporella cf. *errata* (Waters, 1878)

Fig. 3d, e

Description Colony encrusting, unilaminar. Basal autozooids subhexagonal, separated by shallow grooves,

slightly longer than wide, $0.38\text{--}0.46 \times 0.27\text{--}0.43$ mm. Frontal wall slightly convex, evenly perforated by relatively small pseudopores. A blunt, inconspicuous suboral umbo proximal to the sinus in some zooids. Orifice slightly longer than wide. Sinus U-shaped, occupying approximately half proximal width of orifice. Condyles small, bluntly pointed, distinct. Oral spines absent. Avicularium single, proximo-lateral to orifice on right or left. Rostrum tapered to a narrow, blunt tip, directed disto-laterally; crossbar slender, complete, without columella. Ovicells not seen. Ancestrula tatiform, oval.

Remarks Just a few colonies of this species were found, and none were ovicellate. *Schizoporella errata* was originally described by Waters (1878) from the Bay of Naples. The taxonomic confusion involving *S. errata* and similar species of *Schizoporella* was clarified by Tompsett et al. (2009) and Ryland et al. (2014). *S. errata* is a well-known fouler in many ports and harbours worldwide (Ryland 1965; Gordon and Mawatari 1992; Hayward and McKinney 2002; Floerl et al. 2009a; among others). Although several *Schizoporella* species are known from the Brazilian coast, the presence of *S. errata* in Rio de Janeiro harbour was confirmed only recently (Ramalho et al. 2011, and references therein). We have not assigned with certainty the colonies from Quequén Harbour to *S. errata*, because the recent description of the lectotype and topotypic material of this species shows a much wider sinus and relatively fewer and larger pseudopores on the frontal wall (see Tompsett et al. 2009). The identity of several species of *Schizoporella* from Brazil recorded by Marcus (1937), and particularly the status of *S. isabelleana* (d'Orbigny) (see discussion in Winston 2005), should be clarified before a reliable specific assignment of the Southwest Atlantic representatives of this genus can be achieved. No species of *Schizoporella* s.s. had been previously recorded for Argentina (López Gappa 2000).

Voucher material of this species was deposited at MACN (no. 40314).

Cryptosula pallasiana (Moll, 1803)

Eschara pallasiana Moll, 1803: 57.

Cryptosula pallasiana: Lichtschein de Bastida and Bastida (1980): 384, figs. 18–2; Gordon and Mawatari (1992): 29, pl. 1A–C, pl. 3C, pl. 8C; Abdel-Salam and Ramadan (2008b): 11, fig. 4.

Description Material of *C. pallasiana* from the fouling assemblages of three Argentine harbours (including Quequén) was described in detail and illustrated with SEM images by Lichtschein de Bastida and Bastida (1980).

Remarks Thousands of colonies of *C. pallasiana* per square meter were found on all panels. The population was reproducing in June, since many ancestrulae and recently recruited colonies were observed.

Voucher material of this species was deposited at MACN (no. 40315).

Distribution Widespread around the world, particularly in harbours and estuaries (Gordon and Mawatari 1992; Cohen

and Carlton 1995; Floerl et al. 2009a). The species is common from just below mean tide level to the shallow sublittoral (Hayward and Ryland 1998). It is a well-known fouler in Argentina (Lichtschein de Bastida and Bastida 1980).

Discussion

Harbours have proven to be the main entrance point for exotic fauna around the world (Mead et al. 2011). Therefore, measures have been taken to prevent or minimize the establishment of non-indigenous species in harbour environments (Carlton 2010). In Argentina, however, new introduced invertebrates are still repeatedly found established within harbour areas (Orensanz et al. 2002; Spivak et al. 2006; Schwindt et al. 2014; López-Gappa and Liuzzi 2016).

Among the bryozoan foulers found in Quequén Harbour, *Conopeum reticulum*, *Cryptosula pallasiana*, *Fenestrulina delicia* and *Electra monostachys* can be considered established, with populations of hundreds to thousands of colonies per square meter (López-Gappa and Liuzzi 2016; this study). *C. reticulum* and *C. pallasiana* are known to be present in this harbour since at least 1977 (Bastida and Brankevich 1980), while *Aspidelectra melolontha*, *Conopeum seurati* and *Amathia verticillata* may be regarded as more recent introductions. Further sampling will be necessary to determine whether their populations thrive, or whether they should be regarded as chance introductions that eventually failed to persist. *A. verticillata* is considered a highly invasive and harmful species worldwide, and its presence has been extensively documented (Amat and Tempera 2009; Farrapeira 2011; Minchin 2012; Marchini et al. 2015). The species has a very low feasibility of control, since its stolons usually persist and regenerate new colonies (Gossett et al. 2004).

Due to the ability of bryozoans to settle on hard surfaces and the short free larval period, these colonial invertebrates are mainly transported on the hulls of ships (Watts et al. 1998; Gollasch 2002). The successful establishment of non-indigenous species in an environment depends in part on the release of larvae into one location (Lockwood et al. 2005), and in a harbour this is related to vessel traffic (Floerl et al. 2009b; Sylvester et al. 2011). In addition to a small coastal fishing fleet, Quequén Harbour receives more than 220 cargo ships per year from all over the world, thus meeting conditions for a constant supply of propagules transported on ships' hulls to the piers. These may also act as a source for subsequent spread, since once an introduced species has been established, it can colonize the surrounding fleet and be transported to neighbouring areas.

The fouling of Quequén Harbour was intensively surveyed between 1977 and 1983 due to the existence of a power plant cooling water system within the harbour premises (Brankevich et al. 1988, and references therein). After a period

of 26 years without further sampling, in 2009 the number of bryozoan species increased from four to five (Albano 2012), and in 2013 reached a total of 12 species. Since the sampling effort of the 2009 and 2013 surveys was less intensive than those performed in the 1970s and 1980s, the rate of introductions is assumed to have increased during the last few years. This fact emphasizes the need for periodical surveys to detect the possible introduction of non-indigenous taxa and the changes in density and biomass among species already established.

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