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Research Article

Temporal patterns of recruitment and substrate use by the nonindigenous octocoral *Stragulum bicolor* van Ofwegen and Haddad, 2011 (Alcyonacea) in the Southern Brazilian Coast

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Abstract

The nonindigenous octocoral *Stragulum bicolor* was first registered in Brazil in the year 2000, in the estuarine regions of Paranaguá and Cananéia (South/Southeast Brazil). Since then, this species has expanded its distribution along the Brazilian Coast, occurring mainly in estuarine and port areas with high vessel traffic, on several types of artificial and natural substrates. In the present study, the recruitment of *S. bicolor* was monitored for two years (May 2011 to March 2013), in two sites of the Paranaguá Bay (48°W; 25°S). To assess *S. bicolor* recruitment, polyethylene plates were kept submersed for two months. After this period, the plates were collected for laboratory analyses and replaced by new ones. The number of colonies, percentage cover, and type of substrate colonized were analyzed. On both sites, recruitment peaks were registered during the warmer months. However, the number of recruits and percentage cover was higher in one of the sites, probably due to minor influence of freshwater input from rivers and organic pollution from Paranaguá City. Moreover, although recruitment occurred on a greater number of substrates at the island, in both locations the most colonized substrates were the polyethylene plate, the bryozoan *Hippoporina indica*, and barnacle shells. Our data indicate that the population of *S. bicolor* is well established in the Paranaguá Bay and that it is a pioneer in habitat colonization but is also able to recruit on occupied substrates. The ability of *S. bicolor* to overgrow other organisms may result in harmful effects for native species.

Key words: exotic, Cnidaria, experimental plates, artificial substrate

Introduction

Biological invasions has been considered one of the major threats to marine biodiversity (Ruiz and Carlton 2003a). Once introduced, non-indigenous species (NIS) may cause several impacts on the invaded systems, including changes to native species growth, reproduction, and survival, and on community abundance and diversity (Grosholz 2002). Due to the growing shipping traffic in the past few decades as a result of global trade expansion, the transfer of species through ballast water or biofouling on ship hulls has increased, promoting multiple bioinvasion events (Ruiz and Carlton 2003b; Carlton and Ruiz 2005).

The octocoral *Stragulum bicolor* van Ofwegen and Haddad, 2011 was first recorded in Brazil in the year 2000, in the estuarine regions of Paranaguá Bay (Paraná) and Cananéia (São Paulo), South/Southeast Brazil. Over the last few years, its distribution has been spread to Ceará (2001), Rio de Janeiro (2005), Rio Grande do Norte (2006), Santa Catarina (2008), Pernambuco (2011) and Paraíba (2012) (Silva 2008; van Ofwegen and Haddad 2011; Silva et al. 2013; Fernandez et al. 2015; Pérez et al. 2015). This species belongs to a new genus that has been found recently in Brazil, where it has been considered as introduced (van Ofwegen and Haddad 2011; Bumbeer and Rocha 2012; Altvater and Coutinho 2015; Bumbeer and Rocha 2016). *Stragulum bicolor* has very conspicuous, encrusting or lobed colonies of red, pink, or white colour with yellow polyps. The fact that the species has not been previously found by many researchers who conducted studies in the areas where it has been recently recorded provides strong evidence that the species is non-native to the Brazilian coast (van Ofwegen and Haddad 2011). Also, of the ten criteria proposed by Chapman and Carlton (1991) to characterize a species as introduced, *S. bicolor* fits eight of them: 1) Appearance in regions where was not found previously; 2) Initial expansion of local range subsequent to introduction; 3) Association with human mechanisms of dispersal; 4) Association/occurrence with other introduced species; 5) Predominance or restriction to new or artificial environments; 6) Relatively restricted distribution compared to native species distributions; 8) Insufficient active dispersal capabilities to explain the observed distribution of the species; 10) Exotic evolutionary origin (closest morphologic and genetic affinities to species occurring elsewhere in the world). This confirms its status as non-native, at least in the study area.

Since this species was recently described, there is little or no information about several aspects of its biology. The few studies that focused on this species addressed its impacts on the native community (Altvater and Coutinho 2015) or its chemical composition (Sousa et al. 2015; Nuzzo et al. 2016).

Stragulum bicolor exhibits seasonal fluctuations in abundance. In previous studies, it was found more often during spring and summer (van Ofwegen and Haddad 2011; Bumbeer and Rocha 2012). Cangussu et al. (2010) also registered this species (named as Clavulariidae) in late summer, early autumn, and during spring. *Stragulum bicolor* can be found on various types of natural and artificial substrates. In the intertidal zone, it is usually found in places sheltered from light and desiccation, such as the undersides of rocks on the shore. It is also very common in ports and marinas on artificial structures, such as concrete piers, fiberglass floats, plastic, and ropes (personal observation).

In a previous study in Paranaguá Bay using experimental plates, *Stragulum bicolor* colonies were found on sponges, bivalves, barnacles, and bryozoans, among other organisms (Altvater 2009). Likewise, Pérez et al. (2015) recorded this species on twenty-seven taxa of basibionts, including bivalves, polychaetes, cirripeds, sponges, hydrozoans, octocorals, bryozoans, and ascidians. Among sessile benthic marine organisms, competition for space is very intense. The ability of *S. bicolor* to overgrow other organisms suggests a high competitive potential, which can result in harmful effects on native species.

Artificial substrates have become increasingly common in coastal environments, such as bays and estuaries (Bulleri 2005). The type of substrate can influence the composition, diversity, abundance, and distribution of benthic organisms (Calder 1991; Anderson and Underwood 1994; Bulleri and Chapman 2004). Several studies have shown that artificial substrates favor the establishment of exotic species and facilitate their expansion (Bulleri and Chapman 2004; Bulleri and Airoldi 2005; Tyrrell and Byers 2007).

Ports and marinas are suitable areas for the establishment of non-indigenous species (NIS). While vessels act as vectors of introduction and distribution of these species (Floerl and Inglis 2003), the large number of artificial substrates around these areas, provide habitats for biofouling colonization and may represent a step towards the establishment of NIS in natural environments (Ruiz et al. 2009). The two major ports of the Paraná State, Paranaguá and Antonina, are located in Paranaguá Bay/PR (Bigarella 2001), as well as many other small docks. Therefore, in this study, we used experimental plates to monitor the recruitment of *Stragulum bicolor* in Paranaguá Bay, to verify if there is a seasonal pattern of recruitment and abundance, and to determine which substrate (bare plate or other organisms) the species recruits. Experimental plates have been widely used in studies involving fouling communities. The advantage is that they provide a relatively uniform substrate, enabling an increase in replication, easy handling, and control of physical variables such as texture and slope (Glasby and Connell 2001; Watson and Barnes 2004). In the case of recruitment studies, their smooth surface also facilitates the detection and identification of the recruits (Watson and Barnes 2004).

Materials and methods

Study area

The experiments were performed at two different sites of Paranaguá Bay, north coast of Paraná (Figure 1):

1. Cotinga Island (48°28′38″W; 25°31′15″S) is located approximately 4 km north of Paranaguá City. It is influenced by Itiberê, Almeidas, and Guaraguaçu rivers (Figure 1)

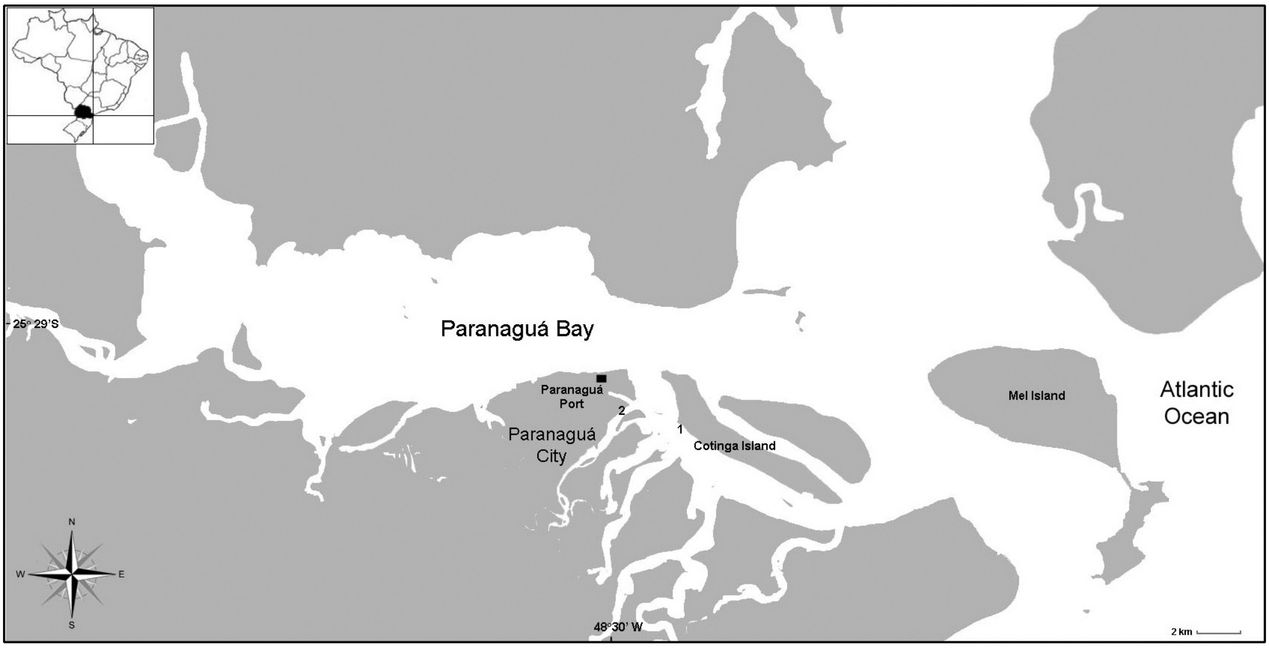

Figure 1. Map of Paranaguá Bay indicating the locations of the experiments (1) Cotinga Island and (2) Paranaguá Yacht Club.

2. Paranaguá Yacht Club (48°30′1.04″W; 25°30′54.73″S) is situated in Paranaguá City, at the mouth of Itiberê River, near the Port of Paranaguá. It is a very eutrophic area because of the sewage discharge from Paranaguá (Figure 1).

Salinity was monitored weekly at the two sites, from March 2011 to June 2012 with a portable refractometer. Weekly sea surface temperature (SST) data from March 2011 to March 2013 were obtained from Physical Oceanography Distributed Active Archive Center PO.DAAC/NASA (OBPG 2015).

Experimental design

The recruitment of *Stragulum bicolor* was monitored for two years, from March 2011 to March 2013. Twelve polyethylene plates (six in each study site), of 15 cm × 15 cm, were fixed transversely to rectangular structures made from PVC pipes, with 15 cm of distance between plates (Figure 2). The structures were immersed at a depth of 1 meter, tied to floating piers of the Paranaguá Yacht Club and Cotinga Island, so that the plates were vertically arranged. After two months of exposure, the plates were recovered for laboratory analysis and replaced by new ones, for a total of 12 exchanges.

In the laboratory, all plates were examined under a stereoscopic microscope (Leica MZ9) (Figure 3). The number of colonies of *S. bicolor* and the type of colonized substrate (bare plate or other organisms) were counted. The coverage percentage of *S. bicolor*, as well as other organisms, in the recruitment plates was estimated using a squared grid (15 × 15 cm), divided equally in 100 squares, superimposed on the experimental plates.

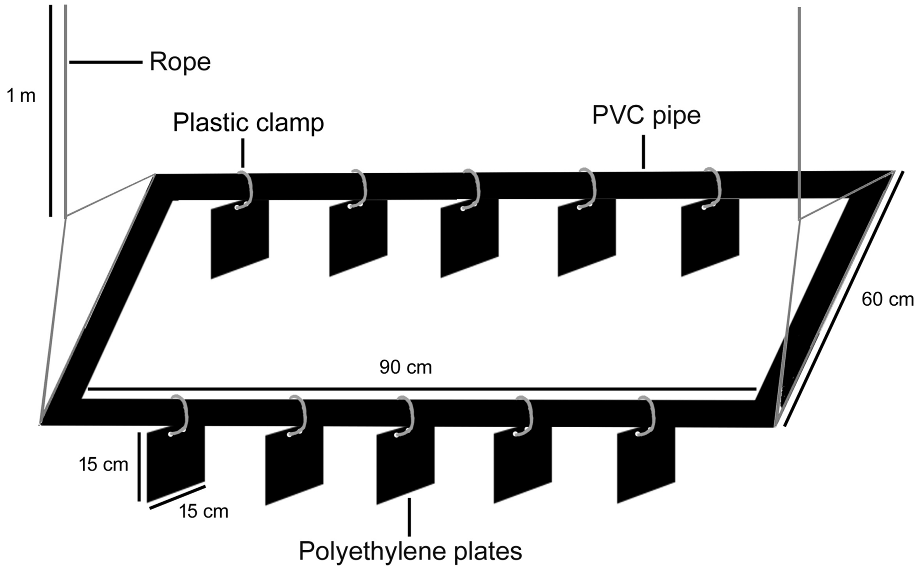

Figure 2. Experimental structures deployed at Paranaguá Bay to monitor the recruitment of *Stragulum bicolor.*

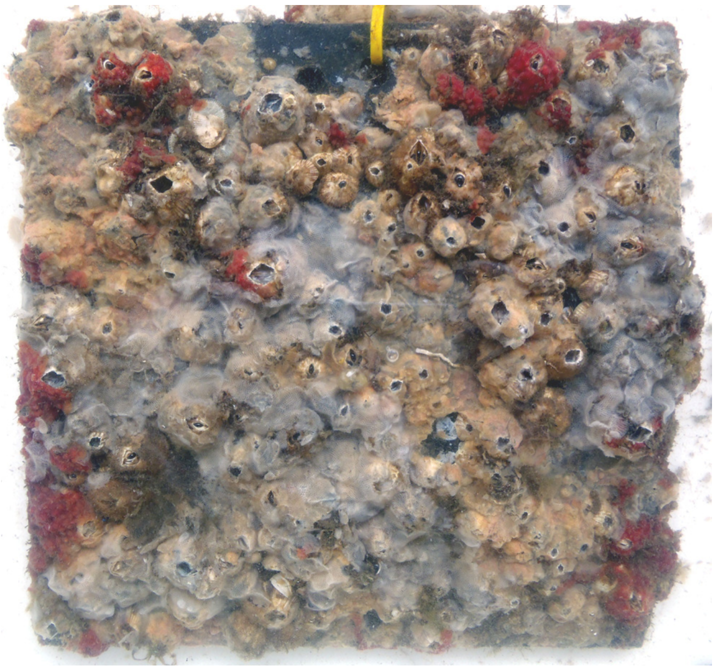

Figure 3. Experimental plates encrusted after two months of exposure.

Sixty-four of the 100 squares were counted. The rows along the edges of the plates (15 mm) were excluded from the analysis as they present different texture characteristics and different exposure to environmental pressures. The presence of the species within the squares was noted and the proportion (expressed as a percentage) of the square occupied by each species was estimated.

Kolmogorov-Smirnov's test was used to verify if the data distribution is different from a normal distribution, while homogeneity of variances was examined by Bartlett's test. Since the data did not comply with these assumptions, the percentage cover was transformed by arcsine$\sqrt{x}$ and the

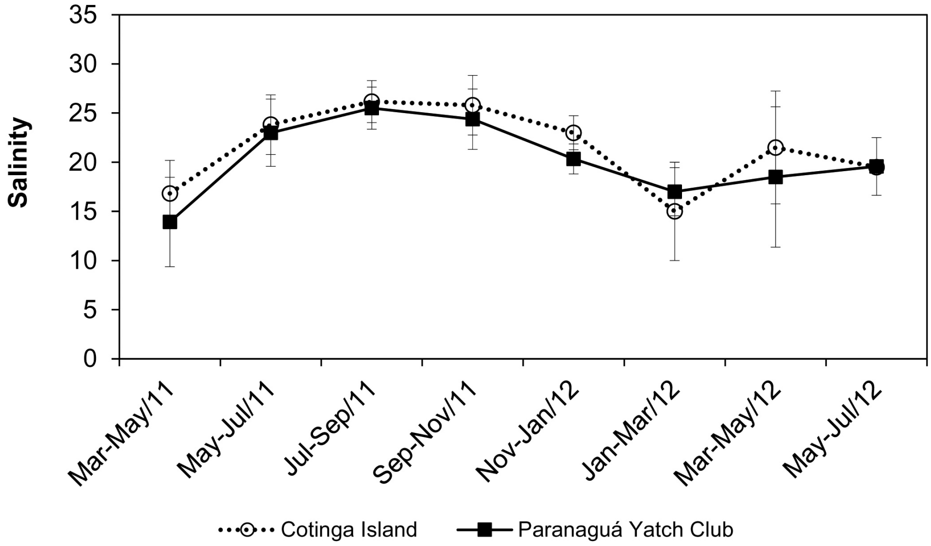

Figure 4. Salinity (Mean ± SD) at the two study areas in Paranaguá Bay/ Paraná.

number of recruits by log (x+1). To check whether the abundance of *S. bicolor* (percentage cover and number of recruits) on each site (Cotinga Island and Paranaguá Yacht Club) was significantly different over time (months/years), a one-way ANOVA was applied, followed by the Tukey's test to identify differences. The Spearman Rank Correlation was used to test the correlation between sea surface temperature (SST) and the recruitment of *S. bicolor* in Paranaguá Bay.

The number of recruits and the percentage cover of *S. bicolor* were compared between the two study sites using the t-test for independent samples, with data transformed to log (x+1) and arcsine√x, respectively. The level of significance was set at $\alpha = 0.05$. Statistical tests were performed using the software Statistica 8 (Statsoft 2007).

Results

Characterization of the study areas

The salinity varied similarly over time in both study areas (Figure 4), however had a greater range of variation at the Yacht Club (10–29 at the Island and 3–28 at the Yacht Club). Over the two years, the average temperature (24 °C) declined from the beginning of autumn (20 °C), rising again in the spring (24 °C) and reaching the maximum value in the summer (29 °C) (Figure 5). Salinity showed an opposite pattern, with the lowest average recorded during the summer (13.9 psu at the Yacht and 15 psu at the Island) and the highest in winter (25.5 psu at the Yacht and 26.2 psu at the Island) (Figure 4).

Recruitment

Altogether, 272 colonies of *Stragulum bicolor* were counted on the recruitment plates at Cotinga Island over the two years of study. Recruitment peaks were registered during the warmest period of the year

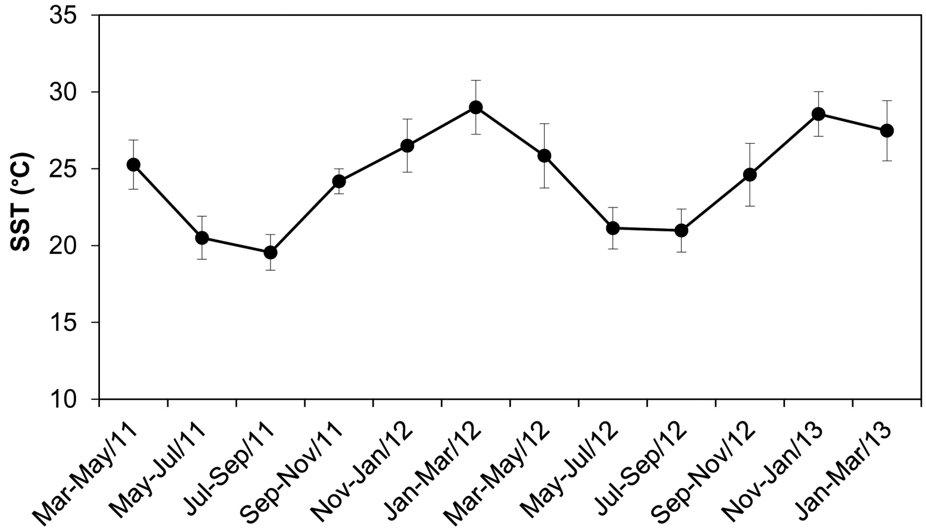

Figure 5. Sea surface temperature (SST) (Mean ± SD) at Paranaguá Bay/ Paraná. Source: Physical Oceanography Distributed Active Archive Center PO.DAAC/ NASA (OBPG 2015).

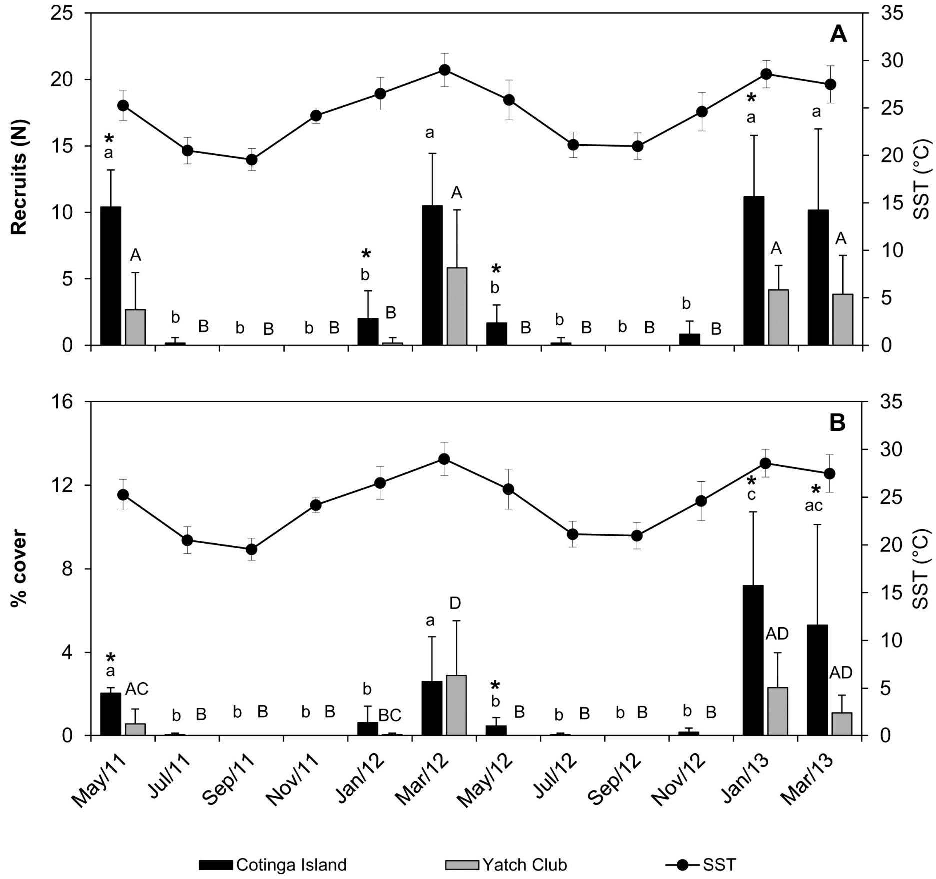

Figure 6. Sea surface temperature (SST) and *Stragulum bicolor* number of recruits (Mean ± SD) (A) and percentage cover (Mean ± SD) (B) on recruitment plates placed at Cotinga Island and the Paranaguá Yacht Club, Paranaguá Bay/Paraná. Significant differences through time were indicated by lowercase letters (Cotinga Island) and uppercase letters (Paranaguá Yacht Club). Significant differences between sites are indicated by asterisk (*).

(Figure 6A, B). Significant differences over time were observed both in the number of recruits (ANOVA $F_{11,59}$ = 32.09; p < 0.001) and in the percentage cover (ANOVA $F_{11,59}$ = 23.17; p < 0.001), which were both significantly higher in May 2011, March 2012, January 2013, and March 2013.

Table 1. T-test for the number of recruits and the coverage percentage of *Stragulum bicolor* between the two study sites at Paranaguá Bay/Paraná: Cotinga Island and Paranaguá Yacht Club. Significant differences were indicated by (*).

	N			%		
	t-value	df	p	t-value	df	p
May/11	4.029	8	0.004*	4.619	8	0.002*
Jul/11	1.000	10	0.341	1.000	10	0.341
Jan/12	2.230	10	0.050*	2.126	10	0.059
Mar/12	1.919	10	0.084	–0.020	10	0.984
May/12	3.909	10	0.003*	4.018	10	0.002*
Jul/12	1.000	10	0.341	1.000	10	0.341
Nov/12	2.153	10	0.057	2.185	10	0.054
Jan/13	3.349	10	0.007*	3.046	10	0.012*
Mar/13	1.869	10	0.091	2.579	10	0.027*

There was a significant correlation between SST and number of recruits (Spearman $r^2 = 0.7990$; $p < 0.05$), as well as percentage cover (Spearman $r^2 = 0.7989$; $p < 0.05$) (Figure 6A, B).

At Paranaguá Yacht Club, a total of 100 colonies of *Stragulum bicolor* were counted on the recruitment plates over the two years of study. As well as on the Cotinga Island, recruitment occurred mainly in the warmer months of the year (Figure 6A, B). In the months of May 2011, March 2012, January 2013, and March 2013 the highest number of recruits (ANOVA $F_{11,59} = 22.39$; $p < 0.001$) were documented, along with the highest percentage cover (ANOVA $F_{11,59} = 18.31$; $p < 0.001$). Recruitment was significantly correlated to SST, both in number of recruits (Spearman $r^2 = 0.7351$; $p < 0.05$) and percentage cover (Spearman $r^2 = 0.7544$; $p < 0.05$) (Figure 6A, B).

Significant differences were observed both in the number of recruits and coverage percentage of *S. bicolor* between the two study sites (Table 1). The number of recruits was significantly higher at Cotinga Island than at the Yacht Club in May 2011, January 2012, May 2012, and January 2013 (Figure 6A). The coverage percentage was higher at Cotinga Island in May 2011, May 2012, January 2013, and March 2013 (Figure 6B).

Habitat characterization and substrate use

Cotinga Island

Two species of algae and forty-seven species of benthic invertebrates were observed on the plates, in addition to *S. bicolor*. Among the invertebrates, two species of Porifera, seventeen Cnidaria, three Cirripedia, two Mollusca, fourteen Bryozoa, eight Ascidiacea and one Entoprocta were registered (Table S1). The bryozoan *Hippoporinna indica* Pillai, 1978 was the predominant species throughout most of the study period (Table S1). In the warmer months of the year, the hydrozoan *Podocoryna loyola* Haddad, Bettim and Miglietta, 2014 and the barnacle *Fistulobalanus citerosum* (Henry, 1974) were the most abundant species (Table S1). During this period a large amount of dead barnacles was also observed. In the cold months, the most abundant organisms were the hydrozoans *Obelia dichotoma*

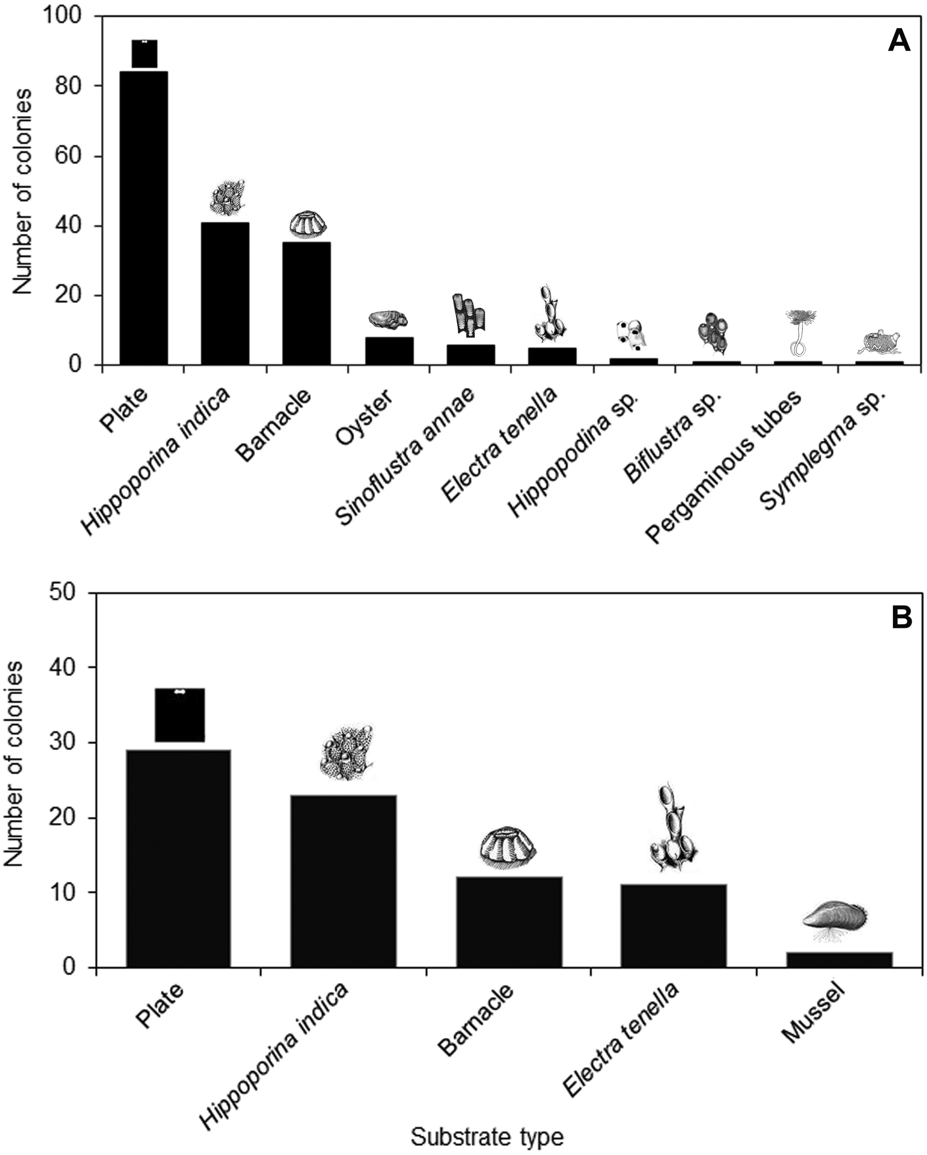

Figure 7. Number of *Stragulum bicolor* recruits on different substrates at Cotinga Island (A) and Paranaguá Yacht Club (B), Paranaguá Bay/ Paraná.

(Linnaeus, 1758) and *Clythia gracilis* (M. Sars, 1850) and the ascidian *Diplosoma* sp., along with young barnacles that could not be identified (Table S1). The bryozoans *Sinoflustra annae* (Osburn, 1953) and *Schyzoporella* sp. showed peaks of abundance during both warm and cold months (Table S1). In some months, unoccupied patches (bare plates) and a large amount of sediment was also observed (Table S1).

Two hundred and forty-five colonies of *S. bicolor* were analyzed to examine the recruited type of substrate. Those that were on more than one type of substrate (N = 61) were discarded from the analysis, as it is not possible to identify which of the substrates was initially recruited. *Stragulum bicolor* recruited over ten different types of substrates: the most colonized was the polyethylene plate (N = 84), followed by the bryozoan *Hippoporina indica* (N = 41) and barnacles (N = 35) (Figure 7A). The other substrate types have been recruited by less than ten colonies each.

Paranaguá Yacht Club

In addition to *S. bicolor*, thirty-seven species of benthic invertebrates and two species of algae were registered on the recruitment plates at the Yacht Club. Among the invertebrates, one species of Porifera, twelve Cnidaria, two Bivalvia, five Cirripedia, twelve Bryozoa, four Ascidiacea, and one Entoprocta were documented (Table S2). In the warmer months of the year, the most abundant species were the bryozoan *Hippoporinna indica*, the barnacle *Fistulobalanus citerosum*, and bivalves of the family Mytilidae, as well as amphipod pergaminous tubes (Table S2). In the colder months, the hydrozoan *Clythia gracilis*, the bryozoans *Conopeum* sp. and *Alcyonidium* sp., the ascidians *Diplosoma* sp. and *Molgula phytophila* Monniot, 1970, and the entoprocta *Barentsia* sp. were more abundant (Table S2). A large number of unoccupied patches (bare plate) and sediment was also observed on the plates in some periods (Table S2).

From the one hundred colonies of *S. bicolor* found on the recruitment plates, twenty-three were on more than one type of substrate and therefore were not considered. *Stragulum bicolor* recruited on five different substrates. At Paranaguá Yacht Club, as well as at Cotinga Island, *S. bicolor* recruited predominantly on polyethylene plates (N = 29), the bryozoan *H. indica* (N = 23), and barnacles (N = 12) (Figure 7B).

Discussion

Stragulum bicolor is a species that has raised controversy about its establishment status. Although it was recently described by van Ofwegen and Haddad (2011) with specimens from Brazil, according to the authors, this species had never been found in benthic environments along the Brazilian Coast until the year 2000. Our results indicate that it is well established in the region of Paraná, with recruitment seasonality and continuous occurrence over the years, as corroborated by Altvater and Coutinho (2015). Taxonomic reviews on the Brazilian Octocorallia found no records of this species in literature and in the biological collections studied (Castro et al. 2010; Castro 1990). The only species of the Clavulariidae family recorded in Brazil is *Carijoa riisei* (Duchassaing and Michelotti, 1860), also considered introduced (Cangussu et al. 2010; Concepcion et al. 2010; Bumbeer and Rocha 2012). *Stragulum bicolor* has characteristics that demonstrate its invasive nature, such as rapid colonisation of artificial substrates, occurring especially in port areas, the increase in abundance shortly after detection and subsequent expansion on natural substrates (van Ofwegen and Haddad 2011). Today, the octocoral *S. bicolor*, first detected in Brazil in the year 2000, is widely distributed along the Brazilian Coast (Silva 2008; van Ofwegen and Haddad 2011; Fernandez et al. 2015; Pérez et al. 2015), being registered in eight states.

At Paranaguá Bay, *S. bicolor* showed some periods of higher abundance of recruits over the two years. In both studied sites, the recruitment peaks were recorded during the same periods (May 2011, March 2012, January 2013, March 2013). The recruitment of benthic organisms is strongly related to the availability of larvae in the environment (Benayahu and Loya 1987; Pineda et al. 2009). The reproductive period length and the timing of the release of gametes varies widely between octocoral species. Tropical species with broadcasting spawning usually have synchronized maturation and release of gametes, whereas brooding species in temperate waters present non-synchronized maturation and extended spawning periods (Simpson 2009). The reproductive cycle of *S. bicolor* was not yet known. Colonies of this species can be observed year-round in substrates near our experimental structures. Therefore, given its recruitment pattern, it seems that this species features a seasonal reproductive period. However, further studies on these aspects are still necessary.

The recruitment pattern of *S. bicolor* also varied spatially, a higher coverage percentage and a larger number of recruits were registered at Cotinga Island in comparison with Paranaguá Yacht Club. In addition, the recruitment occurred over a longer period of time. The average salinity was similar at both sites, however, reached almost 0 at the Yacht Club in some periods, while at the Cotinga Island the lowest salinity registered was 10. In addition, the region of Itiberê River, where is located the Yacht Club, is greatly influenced by domestic sewage from Paranaguá City as were reported by Martins et al. (2010) and Martins et al. (2011) by analyzing sterols concentration.

Biological and ecological processes may also have resulted in differences in the number of recruits and percentage cover of *S. bicolor* between the Yacht Club and Cotinga Island. Recruitment is strongly influenced by the supply of larvae (Connell 1985; Rodriguez et al. 1993; Minchinton and Scheibiling 1991), which can provide spatial and temporal variations. In contrast to the major abundance of recruits on Cotinga Island, Paranaguá Yacht Club has a larger amount of artificial structures where *Stragulum bicolor* is extremely abundant (personal observation). It is possible that colonies from the Paranaguá Yacht Club are supplying larvae to Cotinga Island.

Moreover, according to Osman and Whitlatch (1995), the benthic community already present in the substrate can influence the recruitment. The greatest effect of the resident species is the removal or addition of substrate for settlement. While some species, such as ascidians and bryozoans, can occupy all the available space and inhibit settlement, others, such as barnacles and oysters, increase the amount of substrate and may even attract larvae of some species. Some fast-growing organisms can also overgrow other organisms causing their death, as it is the case of the colonial ascidian genus *Diplosoma* (Osman and Whitlatch 1995), which is highly abundant in Paranaguá Yacht Club (Table S2). At both sites, *S. bicolor* did not recruit on the plates during periods of major abundance of *Diplosoma* sp. (Tables S1 and S2). In addition, predation of newly settled and juveniles can also have an effect on recruitment (Osman and Whitlatch 1998). Some nudibranch species, for example, feed mainly on octocorals (McDonald and Nibakken 1991), as the tritoniid *Marionia limceana* Silva, De Meirelles and Matthews-Cascon, 2013, that was reported feeding exclusively on *S. bicolor* colonies (Silva et al. 2013).

Stragulum bicolor recruited in a wider variety of substrates at Cotinga Island, but in both places the most common were as follows: (1) polyethylene plates; (2) the bryozoan *Hipopporina indica*; and (3) the barnacle shells. On the other hand, some species that were very abundant during the periods of major recruitment of *S. bicolor* (*e.g.* the hydrozoan *Podocoryna loyola*, the bryozoan *Schyzoporella* sp. and the ascidian *Diplosoma* sp.) were not used as substrate to settlement (Tables S1 and S2). Although *S. bicolor* has been common in the experimental structures and highly abundant on concrete pilings and floating piers of Paranaguá Yatch Club and Cotinga Island, it is not abundant on natural substrates around these areas (personal observation). Furthermore, *Stragulum bicolor* is a pioneer species. According to Glasby et al. (2007), pioneer species can be favored by the presence of artificial structures. In agreement to this statement, Tyrrell and Byers (2007) observed that exotic species had greater abundance on artificial substrates than on natural substrates. Likewise, Glasby et al. (2007) found an increased number of non-native species on artificial substrates. The recruitment of native and introduced species is influenced by the composition (artificial and natural), position, and movement of the substrate (Glasby et al. 2007). Artificial substrates seem to favor the development of exotic species and facilitate its expansion (Bulleri and Airoldi 2005).

Stragulum bicolor is an established species in Paranaguá Bay, as suggested by the recruitment data obtained in this two-years study and data from previous studies (Altvater 2009; Cangussu et al. 2010; Altvater and Coutinho 2015). In an experiment performed at the same area during 2007 and 2008, this species was observed both on empty artificial polyethylene plates, as well as on plates that already had a developed community (Altvater 2009). Cangussu et al. (2010) also registered this species (named Clavulariidae) in a high frequency on granite plates submersed at Paranaguá Yacht Club. *Stragulum bicolor* was very abundant in cumulative plates kept for two years at Cotinga Island, in the same period of the present study (Altvater and Coutinho 2015). Paranaguá Bay is a suitable location for the establishment of non-native species due to the following reasons: 1) The ports of Paranaguá and Antonina, and the presence of marinas provide many artificial substrates; 2) There is high boat traffic, which acts as vector for the distribution of exotic species (Floerl and Inglis 2003); 3) Paranaguá Bay is highly affected by anthropogenic disturbances.

Byers (2002) suggests that anthropogenic activities may change the environment in a way that native species lose their competitive advantages over exotic species (Selection Regime Modification). If we consider this mechanism, impacted areas are more susceptible to the introduction of species.

In summary, *S. bicolor* is already an established species in Paranaguá Bay and is able to recruit on various types of substrates, both artificial and natural, including other organisms. In addition, the presence of artificial structures seems to benefit the colonization of this species. Since the eradication of an exotic species once it has become established in an area is difficult, monitoring of *S. bicolor* on Paranaguá Bay is recommended. The monitoring of this species will shed light on its biology and ecology in the introduced range and could help to develop strategies to prevent it from spreading to new areas and increasing in abundance, displacing other species.

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Supplementary material

The following supplementary material is available for this article:

Table S1. Percentage cover of benthic organisms on recruitment plates at Cotinga Island (Paranaguá Bay/Paraná).
Table S2. Percentage cover of benthic organisms on recruitment plates at the Paranaguá Yacht Club (Paranaguá Bay/ Paraná).

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