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CAPTURE OF ANEMONES AND POLYCHAETES IN ARTIFICIAL COLLECTORS FOR ORNAMENTAL PURPOSES, EFFECTS OF: DEPTH, DEPLOYMENT PERIOD, AND TIME OF IMMERSION*

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ABSTRACT

This research aimed to test the catching of ornamental invertebrates in artificial collectors, comparing different types of collectors (vertical and horizontal), deployment period (seasons) and time of immersion (1 to 8 months). The experiments were carried out in an area of mussel farming in Caraguatatuba, southeastern Brazil. Collectors were made of braided nets, both measuring 1 m. Batches of 32 collectors were deployed into the sea at Winter and Spring 2011 and Summer and Autumn 2012. Half of collectors were positioned horizontally at the surface of the sea and the others were positioned vertically, both tied to a floating structure 50 m long. Monthly, two vertical and two horizontal collectors were removed from each batch and examined for detecting ornamentals. Two species were caught: the anemone *Bunodosoma caissarumm* and the polychaete *Branchiomma luctuosum*. Occurrence of anemones was significantly higher in horizontal collectors and lower in collectors deployed during summer. Occurrence was also higher after two to five months of immersion. Polychaete occurrence was significantly higher in vertical collectors deployed during Autumn, being higher after seven months of immersion. We concluded that the system was technically feasible, but an economical evaluation must be done in further studies.

Key words: *Bunodossoma caissarum*; *Branchiomma luctuosum;* aquarium trade; mariculture; settlement.

CAPTURA DE ANÊMONAS E POLIQUETAS EM COLETORES ARTIFICIAIS PARA FINS ORNAMENTAIS: EFEITO DA PROFUNDIDADE, DO PERÍODO DE LANÇAMENTO, E TEMPO DE IMERSÃO

RESUMO

Este trabalho teve como objetivo testar a captura de invertebrados ornamentais em coletores artificiais, comparando diferentes tipos de coletores (verticais e horizontais), período de implantação (estações) e tempos de imersão (1 a 8 meses). Os experimentos foram realizados em uma área de cultivo de mexilhões em Caraguatatuba, sudeste do Brasil. Os coletores foram feitos de redes trançadas, ambos medindo um metro de comprimento. Lotes de 32 coletores foram implantados no mar no inverno e primavera de 2011 e verão e outono de 2012. Metade dos coletores foram posicionados horizontalmente na superfície do mar e os outros foram posicionados verticalmente, ambos amarrados a uma estrutura flutuante de 50 m de comprimento. Mensalmente, dois coletores verticais e dois coletores horizontais foram removidos de cada lote e examinados para a detecção de invertebrados ornamentais. Duas espécies foram capturadas: a anêmona *Bunodosoma caissarumm* e o poliqueta *Branchiomma luctuosum*. A ocorrência de anêmonas foi significativamente maior nos coletores horizontais e menor nos coletores implantados no verão. A ocorrência também foi maior após dois e até cinco meses de imersão. A ocorrência de poliquetas foi significativamente maior nos coletores verticais implantados no outono, sendo maior após sete meses de imersão. Concluímos que o sistema foi tecnicamente viável, mas uma avaliação econômica deve ser feita em estudos posteriores.

Palavras-chave: *Bunodossoma caissarum*; *Branchiomma luctuosum*; aquarismo; maricultura; assentamento.

INTRODUCTION

The global trade of marine species for ornamental proposes has grown significantly in recent decades resulting in a multi-million dollars market (Hardin and Legore, 2005). Besides fish, the aquarium trade involves a wide range of invertebrates (Rhyne et al., 2009; Olivotto et al., 2011). The estimated number of invertebrates is over 500 (excluding corals) although there is taxonomic uncertainty (Wabnitz et al., 2003). Among them, there is a variety of sessile species, including anemones (Olivotto et al., 2011) and polychaetes from the Sabellidae and Serpulidae families (Capa et al., 2010).

Freshwater ornamental trade produces over 90% of organisms in captivity whereas the majority of marine ornamental species are stocked from wild-caught (Wabnitz et al., 2003). The increase and intense capture of marine organisms to support this demand has led to a growing concern due to the potential environmental damage (mainly coral reefs) (Olivotto et al., 2011). This scenario is even more alarming if takes into account the pressures that these environments already face from local sources of pollution and global climate change (Hoegh-Guldberg et al., 2007). In addition, less conscientious traders continue to support the use of destructive fishing techniques, such as the use of cyanide, to anesthetize highly priced fish species, which has caused deleterious effects in non-target species as several marine invertebrates (Mak et al., 2005)

The artificial culture of marine ornamental organisms is one of the solutions aimed to reduce the pressure on natural environments. However, further studies are still required concerning the biology of species and their reproduction in captivity (Pomeroy et al., 2008). On the other hand, some companies have been developing methods for a more sustainable sourcing of ornamental species, one of those methods, known as Post-larvae Capture and Culture (PCC), consists of the capture of planktonic larvae and post-larvae by using light traps and nets allowing their subsequent culture in captivity (ECOCEAN, 2015).

The capture of organisms from the planktonic environment is also being considered in mariculture of mussels, oysters, and scallops where both hard-shells of organisms and artificial substrata increase the area available to settlement of planktonic larvae; these structures also allow the migration juvenile and adults from neighbouring areas (Baine, 2001). The settlement and colonization rate, defined as the rate at which planktonic larvae of benthic organisms establish permanent contact on a substrate depends on a series of complex events, such as different spatial and temporal scales, and physical, chemical and biological processes. The size of the cultivated organism and substratum characteristics also determines the number of potential settlements (Menge, 2000).

To the best of our knowledge, the capture of ornamental invertebrates in artificial collectors, as those used in mariculture, has not been tested yet. However, preliminary observations provided indications that this is feasible. (Helcio Marques personal communication) recorded groups of organisms with ornamental value settled in *Perna perna* mussel growing ropes at Cocanha Beach, Caraguatatuba, SP, Southeastern Brazil. Personal observations also recorded the settlement of ornamental species in mussel seed artificial collectors in the same place, such as anemones *Bunodosoma caissarumm* (Corrêa, 1987) of the Actiniidae family and polychaetes *Branchiomma luctuosum* (Grube, 1869) of the Sabellidae family.

The anemone *B. caissarumm* is endemic from Brazil occurring in high densities in the calm waters of bays and associated with bedrocks (Scremin et al., 2013). The distribution is widespread around the coast from southern Brazil until Fernando de Noronha and São Pedro and São Paulo Archipelago (Gouvea et al., 1989; Scremin et al., 2013). The polychaete *B. luctuosum*, usually occurs in different marine environments, from intertidal zones to deep-sea areas (El Haddad et al., 2008; Licciano et al., 2007). This specie was originally described to the Red Sea as *Sabella (Dasychone) luctuosa* and in the 80s it was first recorded in the Mediterranean. Since then, it has been recorded in various regions of the world (El Haddad et al., 2008; Licciano et al., 2002).

The objective of this study was to test a method to capture *B. caissarumm* and *B. luctuosum* using artificial mussel seed collectors. Thus, the number of organisms settled was determined in different types of collectors (vertical or horizontal), periods of the deployment of collectors into the sea (seasons of the year) and time of immersion (1-8 months), aiming to develop strategies that may foster the sustainable commercial exploitation of this resource.

MATERIAL AND METHODS

Study area

The experiment was conducted from August 2011 to January 2013 in a mussel farm located in an aquaculture area used by MAPEC (Association of Fishermen and Mussel-farmers of Cocanha Beach) in the municipality of Caraguatatuba, on the northern coast of São Paulo, Brazil (23º34'57"S and 45º18'35"W). This area is protected from southern undulations and strong southeastern winds due to a geographical barrier formed by São Sebastião Island, and more locally by the presence of Cocanha Island. The local depth, measured during low and high tides is about 5 m. The bottom is predominantly sandy-muddy with a small presence of consolidated substrate.

Oceanographic variables

Water temperature (thermometer mercury column), salinity (refractometer hydrometer-field) and turbidity (Secchi disk) were monitored weekly during the whole experiment. Levels of chlorophyll-a and total suspended solids (particulate organic matter, POM; and particulate inorganic matter, PIM) were determined fortnightly in water samples collected from the sites of cultivation, about 50 cm deep, using the methods described in APHA (2005). For statistical analysis, the monthly averages were used.

Experimental design

Batches of 32 collectors were deployed into the sea at different times: August/2011 (winter), November/2011 (spring), February/2012 (summer) and May/2012 (autumn). Sixteen of these collectors were positioned horizontally on the surface of the sea at the air-water interface, where there are greater attachments of mussel seeds (Bordon et al., 2011). the other 16 collectors were positioned vertically underneath the water surface (Figure 1).

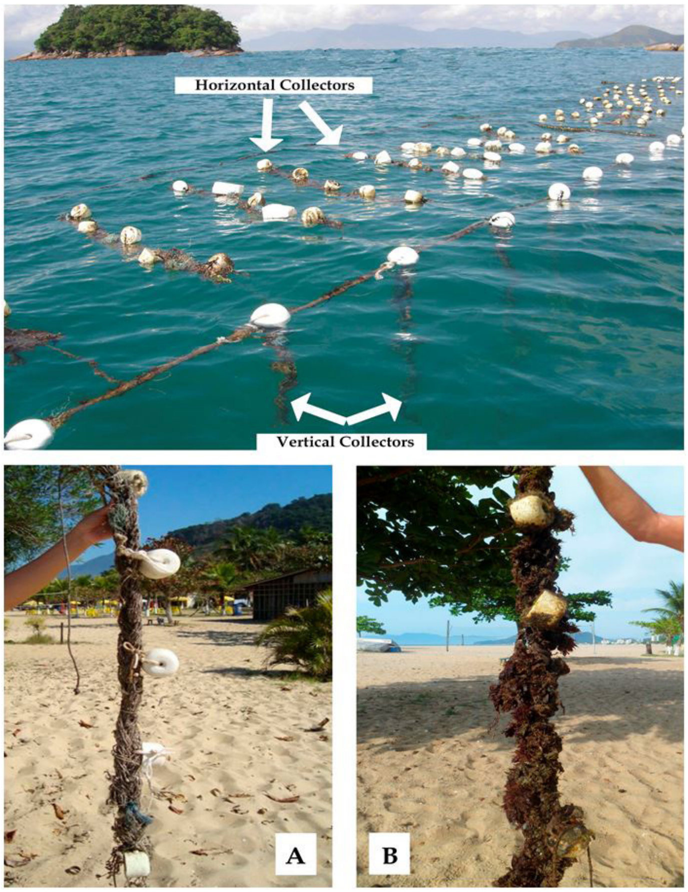

Figure 1. Sixteen collectors positioned horizontally at the surface of the sea at the air-water interface and another 16 positioned vertically underneath the water surface. (A) collector before deployment at the sea, (B) collector after immersion time with organisms already settlement.

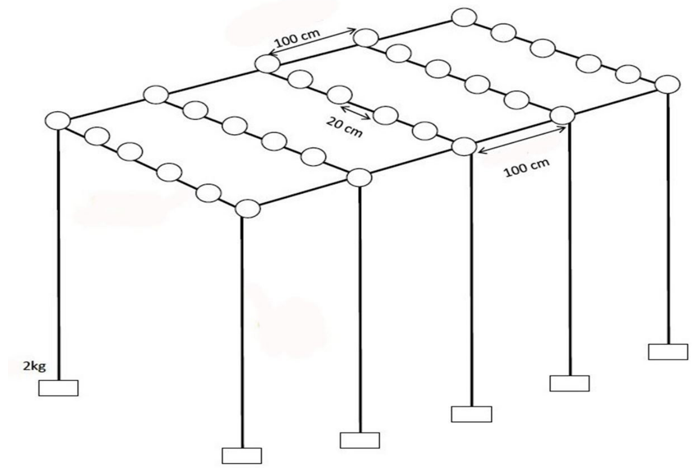

Figure 2. Illustrative structure of collectors (without scale). Collectors had 1 m and made with discharges of polyethylene nets, which were twisted, forming strings approximately 4 cm in diameter. In the horizontal collectors, small buoys were placed apart from each other by 20 cm to ensure their flotation in the vertical ones 2kg concrete ballast was tied at their lower ends.

Both models (horizontal and vertical) were 1 m long and made with discharges of polyethylene nets, which were twisted, forming strings approximately 4 cm in diameter. In the horizontal collectors, small buoys were placed 20 cm apart from each other to ensure their flotation. These collectors were tied together by their ends to a floating structure 50 m long, which comprised of two parallel cables anchored by moorings approximately 1.5 m apart from each other. The distance between the collectors was 1 m. Since the vertical collectors had no buoys, a 2kg concrete ballast was tied at their lower ends. They were suspended vertically with parallel supporting cables, which were equally spaced 1 m away from each other (Figure 2).

Every month (for 8 months) after each deployment, two vertical and two horizontal collectors were removed randomly from each batch and examined for the presence of sea anemone *B. caissarumm* and polychaete *B. luctuosum.* The number of animals settled in each collector and the average value between the two collectors was recorded. Thus, the following variables were compared among treatments and levels of treatments: types of collectors (vertical or horizontal; fixed factor), periods of the deployment of collectors into the sea (seasons of the year; fixed factor) and immersion time (1-8 months; fixed factor).

After faunistic identification and counting, organisms were placed into plastic bags containing local water and oxygen and transported to the laboratory where they were kept alive in aquaria. Other desirable characteristics for ornamental purposes were also observed such as resistance to captivity and compatible coexistence with other organisms (Sprung, 2001). Some specimens of each group were fixed in 70% alcohol after collection for further taxonomic confirmation. Organisms without ornamental value were returned alive to the sea.

Statistical analyses

Kolmogorov–Smirnov and Barlett's tests were used to check for normality of data and homogeneity of variances, respectively. Whenever necessary, data transformation was applied to ensure assumptions.

The variation of oceanographic variables through time was analyzed using one-way analyses of variance ANOVA. The abundance of the targeted organisms was analyzed using a three-way analysis of variance. When ANOVA results were significant ($p<0.05$) the Tukey test was performed to determine differences between months (Zar, 1999).

RESULTS

Oceanographic variables

In general, all oceanographic variables showed temporal variation during the experiment (Figure 3). The average water temperature (±SD) was 24.2 ± 1.3 °C but varied along the experimental duration

(ANOVA, F=4.054, P<0.001). High values of temperature were recorded in the period from December to April, with the highest values being recorded in January 2013 (26.3 °C) and the lowest in July 2012 (21.8 °C) (southern hemisphere summer and winter, respectively).

The salinity averaged 35.9 ± 1.6 g L^{-1} and showed a significant temporal variation (ANOVA, F=3.206, P<0.001), ranging from 30.8 g L^{-1} (January 2013) to 37.5 g L^{-1} (October 2011), with the smallest values in the rainy season (summer).

Differences in transparency along the study period were also recorded (ANOVA, F=3.082, P=0.001). The average was 2.5 ± 0.9 m^{-1}, ranging from 1.2 m^{-1} (September 2011) to 4.5 m^{-1} (December 2012), with smaller values more common between the autumn and spring months.

The content of chlorophyll-a was relatively low but variable (ANOVA, F=3.612, P=0.006) throughout the experimental period, with an average of 0.9 ± 0.2 ug L^{-1} and values from 0.5 ug L^{-1} (October 2011) to 1.4 ug L^{-1} (September 2011).

The particulate organic matter (POM) average was 13.5 ± 5.2 mg L^{-1}, ranging from 7.7 mg L^{-1} (January 2012) to 24.7 mg L^{-1} (October 2012) and showing higher values shortly after the end of winter (early spring) (ANOVA, F=80.894, P<0.001).

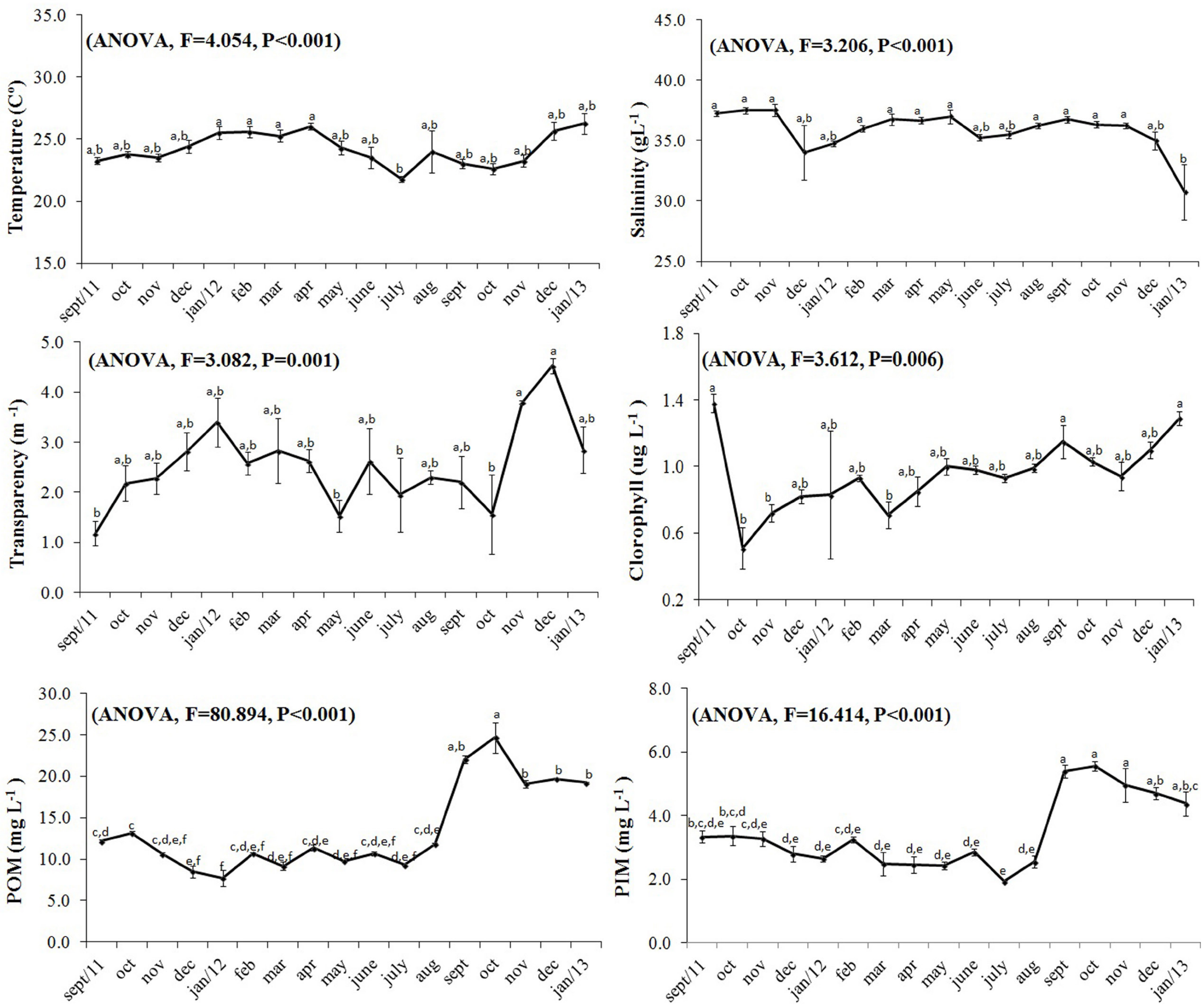

Figure 3. Oceanographic variables during the experiment. Temperature was measuring in C° (±SD) was 24.2 ± 1.3. The salinity in g L^{-1} (±SD) was 24.2 ± 1.3. The transparency in m^{-1} (±SD) was 2.5 ± 0.9. And chlorophyll-a was measuring in ug L^{-1} (±SD) was 0.9 ± 0.2. These parameters were calculated from four samples (n=4). The particulate organic matter (POM) was measuring in mg L^{-1} (±SD) was 13.5 ± 5.2. The inorganic matter (PIM) was measuring in mg L^{-1} (±SD) was 3.4 ± 1.5. These parameters were calculated from two samples (n=4). Different letters indicates significant differences among the months.

The inorganic matter (PIM) averaged 3.4 ± 1.5 mg L^{-1} and ranged from 1.9 mg L^{-1} (July 2012) to 5.6 mg L^{-1} (October 2012), also showing higher values shortly after the end of winter (early spring) (ANOVA, F=16.414, P<0.001).

The influence of types of collectors, season periods to deployment of collectors into the sea, and time of immersion

The settlement of the *B. luctuosum* and *B. caissarum* were registered in both collectors (vertical and horizontal) and in all seasons of the year. The polychaete *B. luctuosum* summed up 410 individuals and anemone *B. caissarum* 223 individuals representing 65% and 35% respectively recorded during the experiment.

Generally, the settlement of organisms in horizontal and vertical collectors started between the second or the third month of immersion (Figures 4 and 5). The interactions between the time of immersion and seasons across the levels of collectors were evaluated as well as the dependence of the effect of this interaction on the level of collectors. (see Table 1 to ANOVA three-way values).

Anemones

Regardless of the period of deployment at the sea or the time of immersion, the occurrence of anemones was significantly higher in the horizontal collectors when compared to the vertical ones (Figure 4). For the collectors deployed during the winter the highest number of individuals occurred on the fifth month of immersion (for both horizontal and vertical collectors). For the ones deployed during the spring, the highest number occurred on the second month of immersion (for both horizontal and vertical collectors as well).

For the ones deployed during the summer, the highest number of individuals occurred during the fourth month of immersion (horizontal collectors) and the seventh month (vertical ones). Forthe ones deployed during autumn, the highest number of individuals

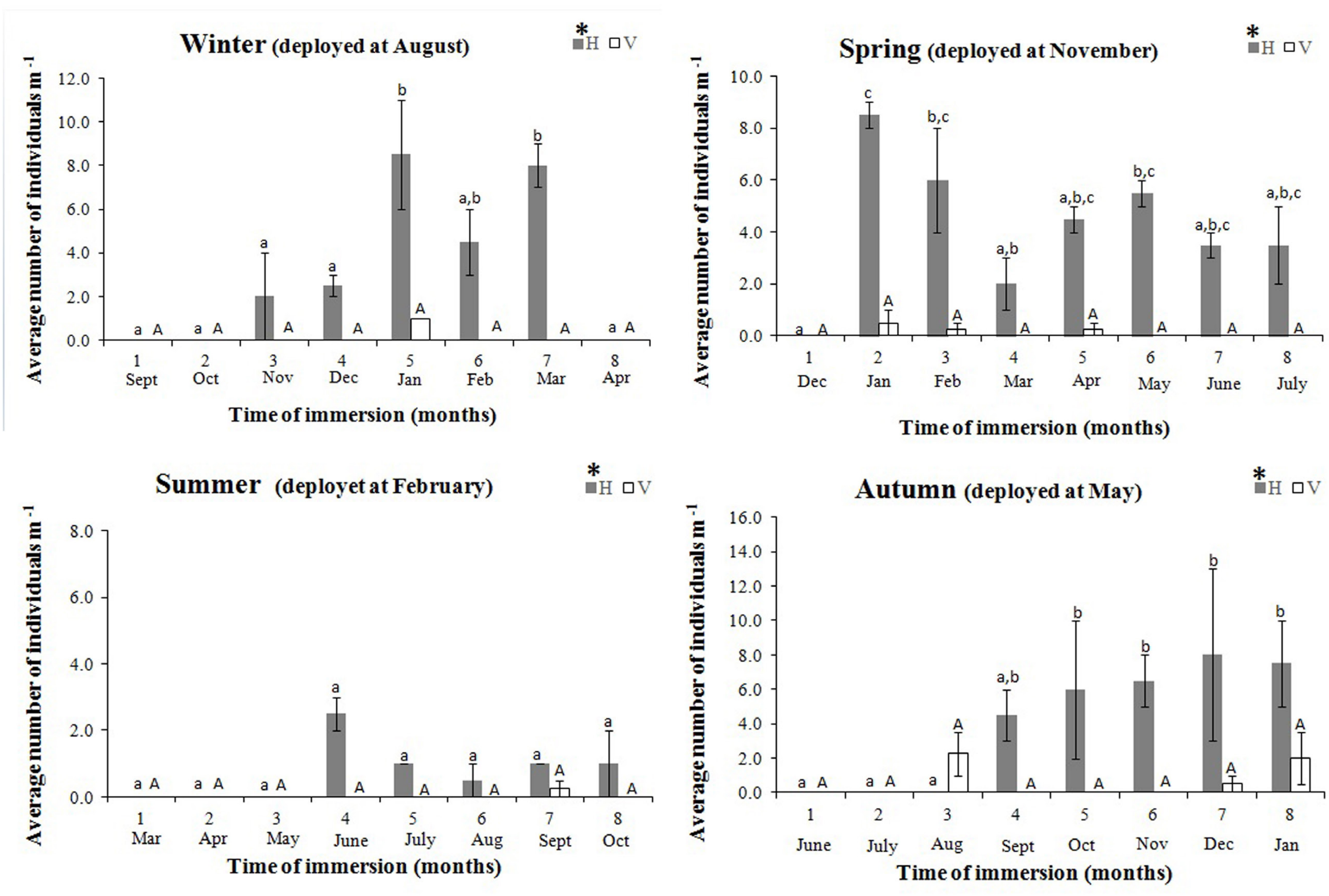

Figure 4. Average (±SD) of number of anemones in different collectors error bars representing standard variation. The * on the H indicates that the number of anemones was higher in horizontal collectors comparing to in vertical ones. For each month (time of immersion) different letters indicates significant differences. Capital letters were used for vertical collectors and lowercase letters were used for the horizontal ones.

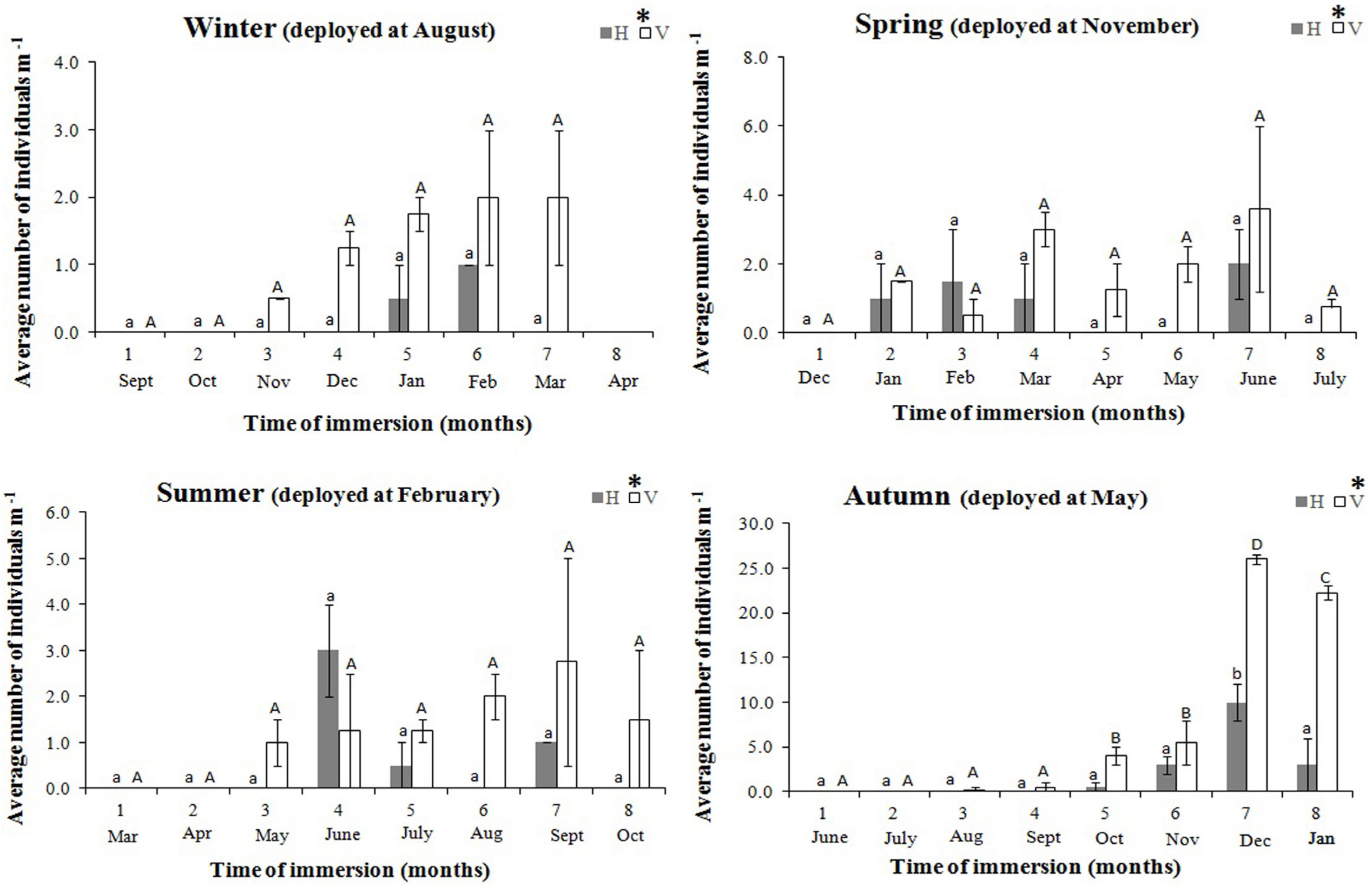

Figure 5. Average (±SD) of number of polychaetes in different collectors error bars representing standard variation. The * on the V indicates that the number of polychaetes was higher in vertical collectors comparing to in horizontal ones. For each month (time of immersion) different letters indicates significant differences. Capital letters were used for vertical collectors and lowercase letters were used for the horizontal.

occurred in the seventh month of immersion (horizontal collectors) and the third month (vertical ones) (Figure 4).

Polychaetes

Regardless of the period of deployment at the sea or the time of immersion, the occurrence of polychaetaes was significantly higher in the vertical collectors when compared to the horizontal ones (Figure 5). For the collectors deployed during the winter, the highest number of individuals occurred in the sixth and seventh months of immersion (vertical collectors) and on the sixth month (horizontal ones). For the ones deployed during the spring, the highest number occurred during the seventh month of immersion (for both collectors vertical and horizontal).

For the ones deployed during the summer the highest number of individuals occurred in the seventh month of immersion (vertical collectors) and in the fourth month (horizontal ones). For the ones deployed during the autumn, the highest number of individuals occurred during the seventh month of immersion (for both vertical and horizontal collectors) (Figure 5).

For the anemones, the number of individuals was significantly higher in the horizontal collectors, and the occurrence of individuals among the seasons was significantly lower for those deployed during the summer and higher for those deployed during autumn, spring and winter.

For the polychaetes, the number of individuals was significantly higher in the vertical collectors, and the occurrence of individuals among the seasons was significantly higher for those deployed during the autumn and lower for those deployed during summer, winter and spring.

DISCUSSION

The oceanographic variables were similar to those registered on the same site by other authors (Bordon et al., 2011; Bernadochi et al., 2016). For example, the low reduction of salinity during the

Table 1. ANOVA three-way interactions.

Source of Variation	DF	SS	MS	F	P
Anemone *Bunodosoma caissarum*					
Time of immersion	7	86,648	12,378	4,967	<0.001
Season	3	73,633	24,544	9,848	<0.001
Type of collector	1	255,945	255,945	102,699	<0.001
Time of immersion X Season	21	160,711	7,653	3,071	<0.001
Time of immersion X Type of collector	7	83,336	11,905	4,777	<0.001
Season X Type of collector	3	51,508	17,169	6,889	<0.001
Time of immersion X Season X Type of collector	21	132,961	6,331	2,541	<0.001
Residual	64	159,500	2,492		
Total	127	1,004,242	7,907		
Polychaete *Branchiomma luctuosum*					
Source of Variation	**DF**	**SS**	**MS**	**F**	**P**
Time of immersion	7	442,898	63,271	42,737	<0.001
Season	3	356,133	118,711	80,185	<0.001
Type of collector	1	114,383	114,383	77,261	<0.001
Time of immersion X Season	21	930,961	44,331	29,944	<0.001
Time of immersion X Type of collector	7	143,398	20,485	13,837	<0.001
Season X Type of collector	3	120,633	40,211	27,161	<0.001
Time of immersion X Season X Type of collector	21	303,711	14,462	9,769	<0.001
Residual	64	94,750	1,480		
Total	127	2,506,867	19,739		

Interactions between the time of immersion and seasons across the levels of collectors. DF: Degrees of Freedoom, SS: Sum of Squares , MS: Mean Square , F: Value, P: Prob > F.

rainiest months (December to March). A high variation of salinity can puts risk on the marine species survival because they cause drastic change in osmotic regulations, therefore, these is one of the most important environmental factors to be checked.

Salinity usually varies considerably in intertidal zones, estuaries, and other biotopes such as in small depths coastal environment (as in this experiment) being more constant in open seas (Berger and Kharazova, 1997). However, our results confirm a low variation. The levels of chlorophyll-a were lower than recorded at the same place (Bordon et al., 2011) with values between 2.1 and 3.1 ug L^{-1}. Our data confirmed that water from the northern coast of São Paulo has oligotrophic characteristics (Castro Filho and Miranda, 1998). Although the chlorophyll-a level was low, the presence of high amounts of POM (usually above 80% of the total soluble solids) can partly compensate the low primary productivity, providing nourishment to suspension-feeder invertebrates. This observation could be confirmed by the low transparency of the water.

The occurrence of the species *B. caissarum* and *B. luctuosum* is also in agreement with the water characteristics, the occurrence of species such as *B. caissarum* is associated with places particularly abundant in amounts of suspended material (Russo and Solé-Cava, 1991) and *B. luctuosum* is also found in areas with higher suspended material and anthropogenic influence (Licciano et al., 2005). Polychaetes are filter-feeders, consuming bacteria, phytoplankton and zooplankton, but also inert materials (particulate organic) (Licciano et al., 2007).

Generally, the settlement of organisms in horizontal and vertical collectors started between the second or the third month of immersion coinciding with the time of periphyton formation. The periphyton is a complex group of bacteria, protozoa, algae, and detritus that are attached to submerged surfaces in most aquatic ecosystems and initiates the process of settlement that takes usually few weeks to 3 months to complete (Railkin, 2003).

The fact that organisms always start appearing between the second or third month independent of the period of deployment possibly was due the small variation of the temperature and brightness among the seasons in tropical regions. These small variations impact less on the speed of periphyton formation and consequently impact less on the speed of recruitment and settlement of species than compared with temperate regions (Whomersley and Picken, 2003; Dziubinsk and Janas, 2007).

The type of collector (horizontal or vertical) influenced collonization of organisms in different ways: the anemone *B. caissarum* being proportionally more abundant in horizontal and the polychaete *B. luctuosum* in vertical collectors.

The highest occurrence of the anemones in the horizontal collectors could be explained by the preference of *B. caissarum* to colonizing areas closer to the surface. This species has a tendency to occupy territory in shallower depths and closer to the waterline when compared to other anemones (Andrea Angeli and Alexander Turra personal communication). *B. caissarum* is an intertidal organism and can be found exposed to the air during low tide or trapped inside upper littoral tidal pools being more tolerant of salinity changes and air exposure. This species also display several adaptations for coping with water and salinity stresses of the intertidal habitat compared to the other anemones (Scremin et al., 2013).

These mechanisms of adaptation are responsible to maintaining tissue hydration such as; mucus secretion, the presence of warts, retaining fluid in the gastrovascular cavities to reduce evaporation, and also the ability to stretch the spine as the level of water lowers leaving the oral disc permanently in contact with the wet surface. In addition *B. caissarum* has a wide tolerance to variation of temperature which may explain their success close to the waterline and in the intertidal zone (Scremin et al., 2013).

The preference of *B. luctuosum* by vertical collectors correlates to studies on ports (El Haddad et al., 2008), which also found a preference by polychaetes on vertical substrates. Vertical surfaces usually present a higher biomass of sessile invertebrates when compared to horizontal surfaces because of the low level of sedimentation (Knott et al., 2004). Horizontal surfaces retain more sediment and may cause increased stress in gill-breathing organisms, such as polychates (Knott et al., 2004). Additionally, the position of the vertical collectors keeps these specimens closer to the mussel growing ropes that can provide some benefits as the high transport of suspended material. Furthermore, polychaetes are species commonly associated with other species and they form dense populations, whereas they rarely live as solitary individuals (Licciano et al., 2005, 2007).

In fact, Gutierrez et al. (2003) and Harstein and Rowden (2004) cite several benefits to invertebrates from the transport of particles released by bivalves. The presence of large mollusc shells create a favourable environment for the settlement and growth of a wide variety of species because they provide food, shade, shelter and also reduce physical stress and predation (Su et al., 2008).

Artificial mussel seed collectors do not contain a high number of shells, and those existing are reduced in size, providing a great difference in the substrate available for the settlement of organisms. This could explain the fact that some groups of ornamental organisms recorded (such as Ophiuroidea, Holothuroidea, and Porifera) in mussel growing ropes also situated in the Cocanha Beach were not observed in this experiment (Helcio Marques personal communication)

It was clear that the pattern of colonization varied according to the period of deployment of collectors. For the capture of anemones, in addition to the horizontal collector being drastically more effective, the best seasons to deploy them at the sea were winter spring and autumn, instead the summer (Summer < Winter = Spring =Autumn). For the capture of polychaetes, in addition to the vertical collector being drastically more effective, the best season to deploy the collectors at the sea is autumn (Summer = Winter = Spring < Autumn).

The significant smallest number of anemones captured in horizontal collectors deployed in summer, could be related to the period that the collectors were exposed to determined conditions. For example, anemones collectors deployed at summer spent more time exposed to low temperatures (which begin to fall in May and stays for June, July and August starting to rise just in September). However, *B. caissarum* can also deal with temperature variations (Scremin et al., 2013) in fact; it is difficult to infer what cause this variation and consequently a low number of individuals in collectors deployed in summer because these difference in the numbers of individuals can also be explained by a complexity of intervening factors. These factors may be correlated with reproductive periods, or locomotion, environmental changes and predation (Su et al., 2008). However, these factors were not accompanied throughout the study.

The same can be applied to polychaetes. It is difficult to infer what cause this variation and consequently a higher number of individuals in collectors deployed in autumn these factors were not accompanied throughout the study.

In farming mussels for example, it is already known that the best period for deployment collectors at sea is in August and February (Bordon et al., 2011) because it coincides with the breeding season of *Perna perna*, leading to a higher and significant settlement. For species targeted in this study more research is needed to access the information about breeding seasons.

A long collector permanency in the water cannot guarantee a high number of organisms, this occurs because of the competition for space and consequent predation reported during the settlement process. Succession and mortality are also determined by intra and interspecific relationships resulting in substrate spatial modification (Gomes et al., 2004; Marenzi et al., 2008). In this study the maximum time that we maintained a collector in the sea was 8 months (same time used by mussel growers). Personal observations show us that after eight months of the permanency collectors in the sea, the number of individuals decreased drastically. This was mainly due to predation.

Our results show that the type of collectors and the deployment period are more important to achieve a higher number of organisms than a longer period of permanence in the sea. In the case of anemones for example, the ideal type of collector is the horizontal one and the best deployment periods are during the autumn winter and spring. This time of the year is also the time when the mussel farmers deploy the horizontal collectors to capture mussel seeds. Thus, even when the main goal by the mussel farmers is the capture of mussel seeds, they can also capture *B. caissarum* individuals.

The results obtained in this study show that the capture of ornamental organisms in artificial mussel seed collectors as those used in mariculture is feasible, at least for the species reported here, and may provide a sustainable alternative option for production to aquarium trade demand promoting environmental conservation. In addition, it can also add value to the mussel producers, although no economic analysis was performed to check this point.

With a low volume but a high value market, the ornamental trade has the potential to provide invaluable economic stability for rural, low-income coastal communities that supply the trade (Butting et al., 2003).

Registers on the capture of ornamental invertebrates in artificial collectors are not found in the literature, although there are examples of wild post larvae of fish and marine invertebrates being harvested for grow-out in captivity (Hair et al., 2004; Lecchini et al., 2006).

This technique may increase the protection to the stocks of the organisms collected, since previous studies showed high mortality rates (>95% in the first week of life) of larvae and post larvae of marine species in their natural environment (Planes and Lecaillon, 2001). Thus, the capture effort described in this research is directed to a portion of the population that would, for the most part, be naturally lost. Therefore, the results may provide an environmental friendly option for production to the aquarium trade demand. It is recommended to perform an economic analysis to check the economic viability of using this technique.

CONCLUSIONS

The capture of ornamental invertebrates in artificial collectors may be technically feasible. The choice of the type of collector (vertical or horizontal), depends on the species to be captured. It was clear that the anemone *B. caissarum* were captured more efficiently in horizontal collectors and the polychaete *B. luctuosum* in vertical ones.

The greater permanence of the collectors in the water does not guarantee a greater capture of organisms. On the other hand, for anemones, the best immersion period depends on the season of launching the collectors, whereas for polychaetes the best immersion time is of six or seven months.

Future studies should include optimization regarding the appropriate times for deployment collectors (taken into account the species reproduction periods), the most efficient collectors (different substratum characteristics), and new environments and depths in order to increase the selectivity of the species, as well as an economic analysis about how this technique can also add value to the mussel producers.

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