First record of *Spirobranchus giganteus* (Pallas, 1766) (Polychaeta, Serpulidae) on Southeastern Brazilian coast: new biofouler and free to live without corals?

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Abstract. The serpulid *Spirobranchus giganteus* is recorded by first time at Arraial do Cabo, Southeastern Brazilian coast, with two important observations of its biology and dispersal: is the first time that this species is recorded living without coral association and the possibility to disperse and colonize new areas as part of biofouling. Until the present, we do not know if this species will spread or disappear in the region, so monitoring dives are needed to follow its distribution.

Keywords: christmas tree worm, tubeworms, marine fouling, introduced species, marine activities

Introduction

Polychaetes included in Sabellida clade are represented by two families: Sabellidae Latreille, 1825 and Serpulidae Rafinesque, 1825. They are easily recognized by the anterior branchial crown and also by a distinct thoracic and abdominal regions. These groups are easiest distinguishable among then: Serpulidae are tubeworms whose tubes are calcareous and Sabellidae are tubeworms with tube made by sediment and mucous (Kupriyanova & Rouse 2008, ten Hove & Kupriyanova 2009). These families are two of the most important polychaetes from benthic hard substrata, mainly on fouling communities (Bastida-Zavala 2008, Tovar-Hernández et al. 2009).

Marine fouling species are subjected to be transported among biogeographical regions by ships and oil platforms hulls, ballast water and aquaculture. Recent studies worldwide put hull fouling as an important, current and ongoing vector for species translocation (Gollasch 2002, Lewis *et al.* 2006, Tovar-Hernandez *et al.* 2009). Dispersion of many serpulid species has been reported from tropical and subtropical harbors in all oceans, and related to this vector (Schwindt & Iribarne 1998, Lewis *et al.* 2006, Bingham 2008, Tovar-Hernández *et al.* 2009).

The Christmas Tree Worm *Spirobranchus giganteus* (Pallas, 1766) (Figure 1) is a tropical calcareous tubeworm, commonly associated to several coral species (Hunte *et al.* 1990), and belongs to a complex-species (Fiege & ten Hove 1999). Many papers described its distribution as obligatory associated to live corals (Marsden *et al.*
1990, Ben-Tzvi et al. 2006, Floros et al. 2005, Petitjean & Myers 2005). They could live for 18-20 years, and mature at a small size (and presumably early age) and produces a large number of very small offspring (Nishi & Nishihira 1996).

Figure 1. Spirobranchus giganteus collected from Buoy, at Arraial do Cabo..Pictures shows the typical radiolar crown, some color variation and lateral view of operculum (A and B). Detail of operculum (D) 20X. Distance between bars= 1mm. Photo by L.F. Skinner

The first record of S. giganteus from Brazil was by Quatrefagues 1865, as Cymospira megasoma and Cymospira rubus from “le Brésil” and from “Bahia” (sensu ten Hove 1970); Zibrowius (1970) recorded S. giganteus from Fernando de Noronha. Paiva (2006a, 2006b) reports the occurrence of this species in Abrolhos reef bank on sedimentary bottom samples, probably eroded from the reefs. Also, S. giganteus is recorded from the coast of Rio Grande do Norte (RN) by Amaral et al. (2006).

The purpose of this paper is to describe the first occurrence of S. giganteus at Arraial do Cabo, on Brazilian southeastern coast, 650 km away of its previous southernmost record, to record its association to artificial substrata, not to coral species as described on literature and also, the transference between artificial substrates.
Methods

Study area. The study area was inside Forno harbor, at Arraial do Cabo (22°58'22.13"S, 42° 0'49.69"W) (Figure 2). This harbor previously operates in salt transfer from NE coast of Brazil but since 90’s, support activities to oil industry have increased and also traffic of ships and platforms to this region. Many exotic species were detected in these years like sponges *Paraleuclilla magna* (Klautau et al. 2004) soft and azooxantheate corals like *Chromonephthea bresiliensis* (previously identified as *Stereonephthya aff. Curvata*) and *Tubastrea coccinea* (Ferreira 2005, Fleury et al. 2005), the bivalve *Isognomom bicolor* (López et al. 2010), the sabellid polychaete *Branchionymna luctuosum* (Costa-Paiva 2006) among others (Lopes 2009). Many of these introductions have been associated to this increase on ship traffic. The main available substrata for fouling organisms on harbor area are the breakwater, formed by large granite boulders, and the pillars of the pier, besides five decommissioned buoys. These buoys has 15m in diameter and 5m deep and its hull is replenished with fouling species, many of them exotic (Coutinho 2009).

We collected the first two individuals of *S. giganteus* on July 2009 from one buoy hull. After taxonomic confirmation, two more individuals were collected on buoy and dissected, and we could record the presence of eggs inside body segments. This indicates that they are reproducing in the region and lead us to look for its presence on available natural or artificial substrata. From July 2009 up to October 2010, we performed 10 scuba dives to search and mapping *S. giganteus* distribution in associations with massive zooxanthelate coral species (*Mussismilia hispida*, *Siderastrea stellata*) and azooxanthelate coral species (*Tubastrea* spp). Other coral species at the study region are *Madracis decactis*, *Phyllangia americana* and the hydrocoral *Millepora alcicornis* (Laborel 1970), but they are not found inside harbor. During these dives, we recorded the presence of three individuals at breakwater and two more at buoy. All individuals collected were found on shallow waters, up to 3 m deep. Also, the individuals collected from breakwater were located very close to buoy, in distances up to 5 m. Specimens were deposited at “Edmundo Ferraz Nonato” Polychaete collection, at UFRJ (IBUFRJ).

Results and discussion

For the first time, *S. giganteus* was recorded at Arraial do Cabo and out of its typical environment: warm temperate waters in coral reef region. Mean water temperature at Anjos Bay is 22.5 °C (Guimaraens & Coutinho, 2000). The presence of some individuals that recruited on breakwater, closer to the buoy, represents its introduction on region, and is based on three aspects: firstly, the absence of any previously register, even photographic, of this wonderful species (Song 2006) on region, and Arraial do Cabo is the most visited dive site on Brazil. Secondly, the presence of many individuals on decommissioned oil buoy hull (pers. obs.) and third, its occurrence only inside harbor area, site favorable to species introduction (Cohen et al. 2005, Lopes 2009). Previous records include Fernando de Noronha Island, Atol das Rocas and Abrolhos bank (Figure 2). Despite Cabo Frio region be recognized as southern limit for many endemic coral species (Laborel 1970, Lins de Barros et al. 2003), mean water temperature is few (circa 2-3) degrees below mean water temperature on northeastern coast and corals could not form a reef, but grow over natural rocks (Lins de Barros et al. 2003).

But, besides the introduction, two additional aspects are very relevant. The first one is the possibility of *S. giganteus* colonizes, be transported and transferred as fouling species between different regions. Carrerette (2010) also detected new records of *S. giganteus*, both on natural and artificial substrates at Sepetiba bay, Rio de Janeiro. Like Arraial do Cabo, these records are performed in an harbor area. These observations at two different bays could indicate that *S. giganteus* is being transferred on Brazilian coast among regions as biofouling species. Other possibilities, less supported by our data are larval transport by ballast water or range expansion due to global climate change.


Buoys were introduced from 2002 to 2006 and are replenished by *Tubastrea coccinea*, a very
invasive species on southeastern Brazilian coast. Densities of *T. coccinea* on buoy are very high (more than 300 colonies) than any site at Arraial do Cabo region, suggesting that it could be the focus itself for several exotic species as noted in other places (Coutinho 2009). Apparently, *S. giganteus* remains restricted to buoy and very few individuals on breakwater.

The second and the most intriguing question, contrasting to literature, was that we do not record *S. giganteus* living associated to hard corals and many authors describe this association as obligatory (Marsden *et al.* 1990; Hunte *et al.* 1990a). In Cozumel, Mexican Caribbean, *S. giganteus* is found in abundance in the first 0-2 meters, associated to several massive scleractinean corals, *Millepora* (Hydrozoa), rocks (Bastida-Zavala & Salazar-Vallejo 2000) and also to piers (Bastida-Zavala Pers. Obs.).

Several field and laboratory experiments were conducted to know factors that influence *S. giganteus* recruitment. Among factors, light (Marsden 1984, 1986, 1990) and coral species presence (Marsden 1987, Marsden *et al.* 1990) are the most studied as a settlement cues to this species. However, as we found *S. giganteus* over buoy hull (iron) surrounded by Didemnidae ascidians (Figure 3) and on rocks from breakwater, without any proximity to coral species, it is possible that other substances or surfaces could signalize settlement location. In the laboratory experiments performed to assess the specificity of *S. giganteus* to coral species (Marsden 1987, Marsden *et al.* 1990) control substrata were coral rubble or glass and they did not isolate the natural larval settlement inducers in these studies. From literature, we know that polychaete larval settlement could be stimulated by several biological, inorganic and substrate surface signals (Qian 1999). Although some marine invertebrate larvae could settle on clean surfaces, settlement on hard surfaces is enhanced by bio-organic film (Unabia & Hadfield 1999, Hammer *et al.* 2001, Lau & Qian 2001) or by surface roughness (Qian *et al.* 1999, 2000, Skinner & Coutinho 2005, Koehl 2007). Sometimes keep clean surfaces could avoid larval settlement (Qian & Pechenick 1998). It is possible that other unknown signals are influencing *S. giganteus* settlement.

Continuous monitoring of *S. giganteus* distribution and reproduction is important for defining the status of the species as potentially invasive or not. Another important conclusion is the need of environmental protection decisions to avoid problems regarding hull colonization by fouling species due large inactivity periods of ships (Floerl & Coutts 2009) and decommissioning of nautical
structures without pre-cleaning (Wanless et al. 2009). Both actions could increase transfer of marine species among marine regions and it is a problem that managers have to deal to prevent species introductions.

Figure 3. *Spirobranchus giganteus* attached to buoy hull surrounded by Didemnidae Ascidia (white) and some anemones.

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