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BRAZILIAN JOURNAL OF OCEANOGRAPHY, 55(1):67-69, 2007

# COMPARISON OF THE REPRODUCTIVE STATUS OF THE SCLERACTINIAN CORAL *SIDERASTREA STELLATA* THROUGHOUT A GRADIENT OF 20º OF LATITUDE

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Most studies on sexual reproduction of scleractinian corals in Brazil have been concentrated in a single population or in a small area (Pires *et al.*, 1999; Francini *et al.*, 2002; Neves & Pires, 2002; Pires & Caparelli, 2002; Pires *et al.*, 2002; Lins-de-Barros *et al.*, 2003). The present paper presents a comparison of the sexual reproductive status of six populations of the Brazilian scleractinian coral *Siderastrea stellata* Verrill, 1868. The six studied sites are distributed along a gradient of latitude of 20º in the Southwestern Tropical Atlantic Ocean, comprising areas throughout almost the whole species geographical distribution (Fig. 1).

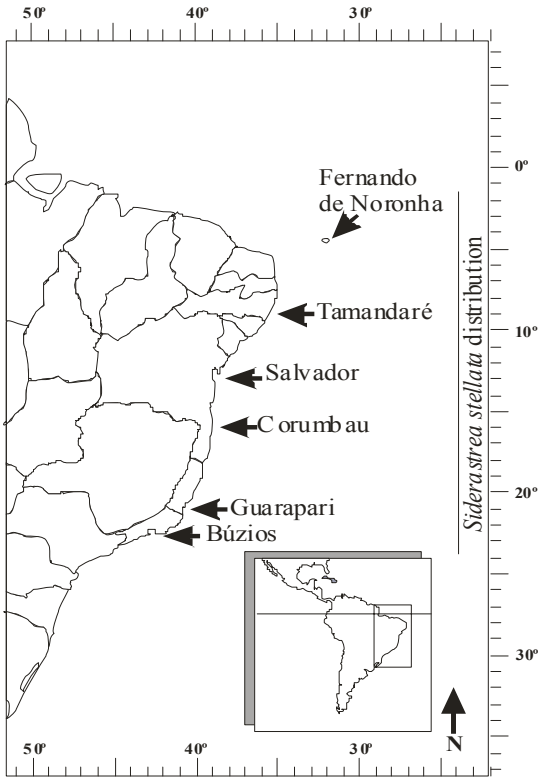


Fig. 1. Reproductive comparison of *Siderastrea stellata*. Map of Brazil, indicating the six studied sites (arrows) and the geographical distribution of *S. stellata* (vertical bar).

*Siderastrea stellata* is endemic and a common coral species in Brazil (Laborel, 1970; Castro & Pires, 2001). It is a colonial, massive and zooxanthellate coral, occurring in all the Brazilian reefs and in coral communities from Maranhão (00°53'S, 044°16'W) to Rio de Janeiro State (23°S, 042°W) (Castro & Pires, 2001) (Fig. 1). In some reef areas, as in the Atol das Rocas (03º52`S, 033º49`W), it is the main reef coral builder species (Echeverría *et al.*, 1997). It usually occurs in shallow waters (up to 10 m depth) and often occupies horizontal substrates (Segal & Castro, 2000). It is considered resistant to sedimentation, temperature and salinity variations, and strong wave action (Laborel, 1970). *Siderastrea stellata* is a gonochoric brooder species, with a high female to male sex ratio and an annual gametogenetic cycle (Lins de Barros *et al.*, 2003). Released planula larvae contain zooxanthelae, settle after 48 hours in close contact with parental polyps. First septal cycle is formed by day 2-3 and colonial development may take many months to occur in laboratory observations (Neves & Silveira, 2003).

Ten colonies of *S. stellata* were collected from each site, at depths around five m and during its reproductive peak. Following Lins de Barros *et al.* (2003), the reproductive peak and planulation of *S. stellata* colonies occur from the end of January to early February in the Abrolhos Reef Complex (18ºS). Collections were carried out in 2001 at the following dates: January 24th at Corumbau (16º54'S; 039º05'W) and Tamandaré (08º46'S; 035º87'W); January 27th at Fernando de Noronha (hereafter called "Noronha") (03º51'S; 032º27'W); and January 29th at Salvador (13ºS), Guarapari (21ºS) and Búzios (23ºS). Colonies were fixed in a 10% formaldehyde-seawater solution and deposited in the Cnidaria Collection of the Museu Nacional/Universidade Federal do Rio de Janeiro.

Colonies were decalcified in a solution of 5% formaldehyde and 10% formic acid and at least 10 polyps of each colony were dissected under a stereomicroscope. The total number of polyps examined was 645. Polyp fecundity was determined by counting all the oocytes within each polyp. The presence of larvae inside polyp coelenteron or being expelled by the mouth was also analyzed. Three

colonies from each site were processed for histological examination. After decalcification, polyps were dehydrated, cleared and embedded in paraffin. Serial cross sections (7 μm) were obtained, and at least ten slides, with up to five polyps each, were produced from each colony using Mallory's Triple stain (Pantin, 1948). Slides were examined under a binocular microscope to determine the stage of gametogenesis and the general condition of tissues, which could indicate recent release of gametes.

Our observations indicated a synchrony of the late development of oocytes among the six sites. All colonies had fertile polyps, and more than 50% of the oocytes observed was mature, with the nucleus at the periphery of the cells (stage III – Lins-de-Barros *et al.*, 2003) (Table 1). However, apparently, planulation season started earlier in colonies from Búzios compared to those from the other five studied sites. Histological analyses showed that mesenteries of the polyps from Búzios colonies seemed brittle, suggesting a recent gamete release. Colonies from Búzios presented the highest percentage of polyps without oocytes (48%), but from those, 13% had larvae (Table 1). Percentage of polyps with larvae from Búzios colonies was also high (32%) compared to the other sites (Table 1). Another fact that indicated that the planulation season of *S. stellata* at Búzios was in its peak at the date of collection (29$^{th}$ January 2001), was the low average number of oocytes per polyp observed (1.86 ± 3.44 oocytes/polyp [mean ± SD]; (Table 1). The low polyp fecundity and high percentage of polyps without oocytes suggested that fecundation of most oocytes had already occurred, generating larvae, that were being released. Colonies from Búzios collected by the end of December 1999 and beginning of January 2000 (13 months before the collections of the present study) had at least five oocytes per mesentery, approximately 140 oocytes per polyp (unpublished data).

In contrast to Búzios, colonies from the other five sites showed a small percentage of polyps without oocytes (Table 1). However, as occurred in Búzios, planulation season had also started, since larvae inside the polyps were always observed (Table 1). However, the percentage of polyps with oocytes (100% of the examined polyps of colonies from Noronha and Guarapari had oocytes) and high polyp fecundity *versus* low number of larvae (Table 1) suggested that most of the oocytes produced had not been fertilized yet.

Búzios was the southernmost studied site (23$^{o}$S) and is near the southern limit of the *S. stellata* geographical distribution. It is localized in the Cabo Frio region, characterized by an upwelling phenomenon which occurs mostly during January and February, when minimum sea water temperatures can drop to circa 18$^{o}$C (Valentin & Moreira, 1978). Francini *et al.* (2002) also discussed that the gamete release of *Mussismilia hispida* colonies from Búzios (23$^{o}$S) was asynchronous when compared to colonies from Abrolhos (18$^{o}$S) and Santos (24$^{o}$S). The influence of temperature on coral reproduction is widely recognized (Wallace, 1985; Shlesinger *et al.*, 1998; Pires *et al.*, 1999; Heltzel & Babcock, 2002; Lins de Barros *et al.*, 2003). The regulatory influence of upwelling on coral reproduction in Búzios, which specifically anticipates the onset of planulation of *S. stellata*, should be considered, but further studies are necessary to draw sound conclusions.

## Acknowledgements

This research was funded by the "Fundação O Boticário de Proteção da Natureza" and the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq). We also thank the Brazilian Environmental Agency (IBAMA), for providing collecting permits. We thank to A. Baird for valuable suggestions and text revision.

Table 1. Reproductive data of colonies of *Siderastrea stellata* collected in six sites, comprising a gradient of 20$^{o}$ of latitude. "N": number of polyps examined; "Fecundity": average number of oocytes per polyp; "n": number of oocytes measured and classified according to their development stage. For descriptions of stages I, II and III of oogenesis of *S. stellata* see Lins de Barros *et al.*, 2003.

| | N | Fecundity | % without oocytes | % with larvae | n | % stage I | % stage II | % stage III |
|---|---|---|---|---|---|---|---|---|
| Noronha | 100 | 38 (± 27.52) | 0 | 37 | 43 | 4.65 | 44.19 | 51.16 |
| Tamandaré | 120 | 6 (± 6.62) | 26 | 14 | 48 | 0 | 33.33 | 66.67 |
| Salvador | 102 | 31 (± 12.59) | 3 | 12 | 19 | 0 | 5.26 | 94.74 |
| Corumbau | 112 | 8 (± 8.03) | 20 | 25 | 20 | 0 | 0 | 100 |
| Guarapari | 91 | 83 (± 30.31) | 0 | 19 | 42 | 0 | 33.33 | 66.67 |
| Búzios | 119 | 1.84 (± 3.44) | 48 | 32 | 11 | 0 | 0 | 100 |

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*(Manuscript received 03 Marchr 2006; revised 06 September 2006; accepted 27 October 2006)*