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SOME DIATOMS ATTACHED TO SCLERACTINIAN CORALS FROM NORTHEAST BRAZIL

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ABSTRACT

The phenomenon of symbiosis between microalgae (including diatoms) and marine invertebrates has been recognized for over a century. The objective of this study was to effectuate a floristic assessment of the diatoms associated to the corals *Favia gravida* and *Porites astreoides* collected on Tamandaré Beach (Pernambuco State, Northeast Brazil). Colonies of these scleractinians were collected in the months of March and April 1998 from depths between 0 and 2m using a chisel and hammer. The collected corals were stored in plastic bags full of seawater and transported to the "Laboratório de Ambientes Recifais" of the UFRPE. The corals' tissue was extracted with a high-pressure jet of water (Water Pik). The extracted tissue was homogenized by maceration and the diatoms found in this homogenate were studied using a standard microscope and permanent slides. The floristic assessment of both *F. gravida* and *P. astreoides* was representative of their associated diatoms. A total of 20 taxa of diatoms were identified, of which 17 were associated with *F. gravida* and 10 with *P. astreoides*.

Keywords: Floristic assessment, diatoms, Scleractinia, symbiosis, northeastern Brazil.
Descritores: Levantamento florístico, diatomáceas, Scleractinia, simbiose, nordeste do Brasil.

INTRODUCTION

A serious problem in the study of symbiosis is the difficulty in the identification of the several species of microalgae commonly found associated with marine invertebrates. This problem has been taken into consideration since the late 19^{th} century, when BRANDT (1881, 1882) recognized the green and yellow cells found in several host groups, including members of the Porifera, Cnidaria and Mollusca as microalgae.

The literature has many examples of these relationships, even in loricate Oligotrichida protozoans (EHRENBERG, 1834; DADAY, 1887; JÖRGENSEN, 1924; KOFOID and CAMPBELL, 1929; PAVILLARD, 1916, 1935; etc.). However, even though this type of association has been recognized for long, it has not been studied enough. Therefore, most of the advantages and disadvantages these relationships bring to the animals involved are still obscure.

It has been suggested that in scleractinian corals the endosymbiont microalgae (zooxanthellae) could be parasitic dinoflagellates (HOVASSE, 1922). However, it is now known that they are symbionts (KAWAGUTI, 1944) that interact with the corals and translocate reduced organic carbon and nitrogen to the host; at the same time they recycle nutrients like phosphorus and nitrogen inside the host's cell and accelerate the coral's calcium deposition pattern (MUSCATINE, 1974; COSTA, 2001). In addition, MULLER-PARKER *et al.* (1988) have suggested that these algae could serve as a type of "kidney" in the corals' tissue due to their nutrient recycling role.

Today it is accepted that there is a great taxonomic diversity of microalgae associated to several marine invertebrates and cnidarians (TRENCH, 1993). However, this list is still short and not all of these organisms are necessarily involved in an intracellular mutualistic symbiosis such as the zooxanthellae.

It is true that some species can be opportunistic and take advantage of the favorable environment offered by the corals. This might be the case of the diatoms which, although found in association with some corals (PIYAKARNCHANA *et al.*, 1986; COSTA, 1998), do not seem to have any special function for their host.

The purpose of this study was to identify the diatoms found in slides prepared for the study of zooxanthellae associated to the scleractinian corals *Favia gravida* and *Porites astreoides* collected in the coastal reefs of Tamandaré Beach (Pernambuco State, 08° 47' 2" S and 35° 06' 45" W, northeastern Brazil). Although there are several studies on planktonic and benthic diatoms of Brazil (TORGAN, 1983, 1985, SILVA-CUNHA and ESKINAZI-LEÇA, 1990), references of studies on these organisms in association with hermatypic corals are unknown.

MATERIAL AND METHODS

Samples of the corals *Favia gravida* and *Porites astreoides* were collected in the months of March and April 1998 by free diving from depths of 0 to 2 m with the aid of a chisel and hammer. The samples were kept in aerated seawater. Tissue was extracted from each species with a high-pressure jet of water (Water Pik). The material was then mechanically homogenized in 20 ml of filtrated seawater. Droplets were placed between slides and cover slips and the material was analyzed under a microscope. Diatoms were observed along with the zooxanthellae extracted. Sub-samples containing diatoms were extracted, concentrated in a centrifuge, and submitted to the oxidation process suggested by HASLE and FRYXELL (1970). Permanent slides were then confectioned with the material and were analyzed under several powers of a microscope. The diatoms found were photographed and identified based on studies by CUPP (1943), HENDEY

(1964), RICARD (1987), SILVA-CUNHA and ESKINAZI-LEÇA (1990), and PACOBAHYBA (1992). For confirmation on the synonyms a study by MOREIRA FILHO *et al.* (1999) was consulted.

RESULTS

Twenty diatom taxa, distributed among 9 families and 17 genera, were identified in the material examined. Of the 17 genera, 12 were identified at a specific level. A total of 7 taxa were common to the two coral species studied. The greatest taxonomic diversity was found in *F. gravida*. In both corals, however, species of the Order Pennales (Tab. 1) were predominant.

TABLE – 1: Diatoms found in the corals *Favia gravida* and *Porites astreoides* collected in Tamandaré Beach (Pernambuco State, northeastern Brazil) in the months of March and April 1998. (C = Order Centrales; P = Order Pennales).

DIATOMS		CORAL SPECIES	
Species	Orders	*Favia gravida*	*Porites astreoides*
Actinocyclus sp.	C	X	
Amphora angusta	P	X	
Campyloneis grevillei	C	X	
Campyloneis sp. 1	C		X
Climacosphenia moniligera	P	X	
Cocconeis scutellum	P	X	X
Coscinodiscus sp.	C	X	X
Diploneis sp. 1	P	X	X
Diploneis sp. 2	P	X	
Eunotia sp.	P	X	X
Grammatophora angulosa	P		X
Grammatophora oceanica	P	X	
Licmophora abbreviata	P	X	
Navicula sp.	P	X	X
Paralia sulcata	P	X	X
Pinnularia sp.	P		X
Psammodictyon panduriforme	P	X	X
Rhaphoneis amphiceros f. *quadrata*	P	X	
Synedra tabulata	P	X	
Triceratium dubium	P	X	
TOTAL		17	10

All taxa are common in the littoral zone, where they occur as epibenthic organisms, although they can also be found among the plankton. Below are some of the ecological characteristics of the identified species:

1 - *Amphora angusta* Gregory (Biraphidales Cymbellaceae): Marine species of the littoral zone; epiphyte; polyhalobic; euryhaline (MOREIRA FILHO *et al.*,1975).

2 - *Campyloneis grevillei* (Smith) Grunow (Monoraphidales Achnantaceae): Marine species of the littoral zone; epiphyte. Frequently found in tropical seas (ESKINAZI-LEÇA and VASCONCELOS FILHO, 1972).

3 - *Climacosphenia moniligera* Ehrenberg (Araphidales Fragilariaceae): Marine species; epiphyte; abundant in tropical seas; cosmopolitan. (MOREIRA FILHO *et al.*, 1967). According to CUPP (1943), a marine species of the littoral zone; neritic; abundant in warm waters.

4 - *Cocconeis scutellum* Ehrenberg (Monoraphidales Achnantaceae): Marine neritic species; epiphyte; euryhaline; cosmopolitan (MOREIRA FILHO and MOMOLI, 1962).

5 - *Grammatophora angulosa* Ehrenberg (Araphidales Fragilariaceae): Marine species; epiphyte. Cosmopolitan (MOREIRA FILHO *et al.*, 1967).

6 - *Grammatophora oceanica* (Ehrenberg) Grunow (Araphidales Fragilariaceae): Marine species of the littoral zone, occasionally found in plankton collections near the coast. Wide distribution (CUPP, 1943). MOREIRA FILHO *et al.* (1967) consider it an epiphyte, euhalobic, euryhaline, and cosmopolitan species.

7 - *Licmophora abbreviata* Agardh (Araphidales Fragilariaceae): Epiphyte species of the littoral zone, yet found frequently in plankton collections. Cosmopolitan (CUPP, 1943).

8 - *Paralia sulcata* (Ehrenberg) Kutzing (Discales Coscinodiscaceae): Marine species; mesohalobic to polyhalobic; frequently found in the benthic littoral zone; euryhaline; occasionally planktonic (MOREIRA FILHO *et al.*, 1975).

9 - *Psammodictyon panduriforme* (Gregory) Mann (Biraphidales Nitzschiaceae): Marine species of the littoral zone; mesohalobic; euryhaline; occasionally planktonic (MOREIRA FILHO *et al.*, 1975, as *Nitzschia panduriformis*).

10 - *Rhaphoneis amphiceros* f. *quadrata* Ehrenberg (Araphidales Fragilariaceae): Marine species of the littoral zone, also found in estuaries. Cosmopolitan (MOREIRA FILHO *et al.*, 1967).

11 - *Synedra tabulata* (Agardh) Kutzing (Araphidales Fragilariaceae): Marine species of the littoral zone; mesohalobic; euryhaline (MOREIRA FILHO *et al.*, 1975).

12 - *Triceratium dubium* Brightwell (Biddulphiales: Biddulphiaceae): Marine species of the littoral zone; rare (MOREIRA FILHO *et al.*, 1967).

DISCUSSION

Although the literature mentions several kinds of epizoic associations between diatoms and marine animals (TRENCH, 1997), few have been documented for scleractinans. The expressive number of taxa found in this study strongly indicates that different coral species can host distinct microalgae assemblages (PYAKARNCHANA *et al.*, 1986) and calls for a more appropriate study.

Attention must be called to the fact that these diatoms occurred in both species of corals studied, as this is not the preferential habitat of these microalgae. Most of the taxa found represent littoral forms, also common in the neritic zone, and that normally occur as benthic and epiphyte forms, forming microphytobenthic communities. Therefore associations between diatoms and corals do not represent a perfect mutualistic symbiosis and it is quite possible that this type of interaction brings more benefits to the diatoms than to the corals.

Coral reefs are recognized around the world as environments rich in oligotrophic waters, which favor epibenthic diatoms much more than planktonic ones. The opportunistic nature of many diatom species can make them successful as epizoic organisms; however, whether they are an advantage to the corals is still questionable. Their real importance is probably inexpressive since, according to FERRIER-PAGÈS *et al.* (1998), the largest nutritional contribution to corals comes from their zooxanthellae (COSTA, 2001) and from the phyto and zooplankton of surrounding waters.

Reef regions are normally rich in diatom diversity (PIYAKARNCHANA *et al.*, 1986; SASSI, 1987; COCQUYT, 1992) and several of these can be very successful also as epizoic forms. The efficient use of products excreted by the host, the photic conditions offered, and the advantage of nutrient reuse are strong factors in the success of this type of interaction with the corals.

It is also possible that the success in the colonization of these microalgae is related to the type of skeleton of the coral that serves as substrate. *Favia gravida* has a growth form that is predominantly hemispheric, and meandroid corallites, elongate or rounded (AMARAL, 1991). *Porites astreoides* has a colony form that is initially incrusting and later spherical with rounded protuberances (LABOREL, 1970). These apparently bizarre forms may create much more favorable habitat conditions for the diatoms, making possible the use of the photic and nutritional conditions of the surrounding waters in a more efficient way. Therefore, efficiency favorable to the diatoms, not mutualism, seems to control the presence of these algae on the corals; possibly it is a type of unilateral cooperation in which only the algae are really benefited.

For the corals, endosymbiont algae (zooxanthellae) are what are truly important (MUSCATINE, 1974; MULLER-PARKER *et al.*, 1988). Yet the presence of diatoms associated to corals serves as an alert for the studies of zooxanthellae, especially when productivity or photosynthesizing pigment measurements are taken, as their presence, even in small densities, can be a source of interference that must be taken into consideration and studied.

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