

## CONSIDERATIONS ABOUT *Coscinodiscus wailesii* (DIATOMEAE) ON THE SANTA CATARINA ISLAND COAST, BRAZIL

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*Coscinodiscus wailesii* Gran et Angst, first described in the Pacific Ocean by Hasle and Lange (1992) but which has since been occupying oceans and coastal seas all over the world, is considered an invasive species. It is frequently found in high concentrations as the dominant organism with densities higher than 90% (DÜRSELEN; RICK, 1999; EDWARDS et al., 2001). In Brazil it has only been registered in recent studies such as those undertaken by Valente-Moreira (1987), Moreira-Filho et al. (1990), Souza-Mosimann et al. (1993), Fernandes et al. (2001) and Tenenbaum et al. (2004). It is likely that the species was introduced by the discharge of ballast water (FERNANDES et al., 2001).

The register of *C. wailesii* in Brazilian waters only as recently as 1987 may also be due to a misidentification as it is very similar to *C. concinnus* Wm. Smith. As Wiltshire and Dürselen (2004) emphasize, both species co-exist in the North Sea and have similar dimensions. It suggests that this confusion might have arisen in studies conducted in Brazil. There exists, therefore, the possibility that the occurrence of *C. wailesii* in Brazilian waters anteceded any existing publication on it.

As an invasive organism *C. wailesii* replaces the native phytoplankton by competition, decreasing biodiversity (EDWARDS et al., 2001). The success of the species is related to its resistance to different temperatures and salinities, higher tolerance to heavy metals than is shown by native species and the large size of its cells, unpalatable to planktonic herbivores (DÜRSELEN; RICK, 1999).

*Coscinodiscus wailesii* is considered a potentially harmful species due to its production of insoluble mucilage which adversely affects fishing activities (EDWARDS et al., 2001). These organisms develop high biomass leading to oxygen and nutrient depletion, adversely affecting mussel and seaweed

cultivation (FERNANDES et al., 2001; PROENÇA; FERNANDES, 2004). The depletion of inorganic nitrogen in areas cultivated with the seaweed *Porphyra* (Nori) causes talus whitening and consequent economic loss (NISHIKAWA; YAMAGUCHI, 2008). It is important to consider the potential economic impact of *C. wailesii* in estuaries and coastal areas, especially in the Santa Catarina State where large mariculture projects are undertaken.

This study presents the cell characterization and aspects of the distribution of *C. wailesii* in the Santa Catarina Island coastal waters.

The samples analyzed were collected at three sites on Santa Catarina Island, South-Western Atlantic, Brazil (Fig. 1): the Ratoes Grande Station (RGS) (27°28'30.52"S - 48°33'27.27"W) and Guarazes Station (GS) (27°33'20.09"S - 48°33'27.50"W) on the central-west coast and Pantano do Sul Station (PSS) (27°47'24.97"S - 48°30'39.31"W) in the south-east. The RGS and GS stations receive the influence of the rivers and mangrove swamps of Ratoes and Itacorubi mainly as regards their nutrient contribution, which includes phosphorus and nitrogen, and of the fresh water draining from the adjacent continental areas (PAGLIOSA et al., 2005; PAGLIOSA et al., 2006). The PSS station is located in an area open to the sea.

Sampling was carried out monthly from January 2007 to January 2008. Water was collected from the surface. Temperature and salinity were measured *in situ*, with an Arba thermometer and a Shibuya refractometer.

*Coscinodiscus wailesii* cells were quantified using an inverted microscope and following Utermöhl (1958). A complete 5 ml chamber was counted for each sample. Ten to thirty transects in a 1ml chamber were counted for total phytoplankton.

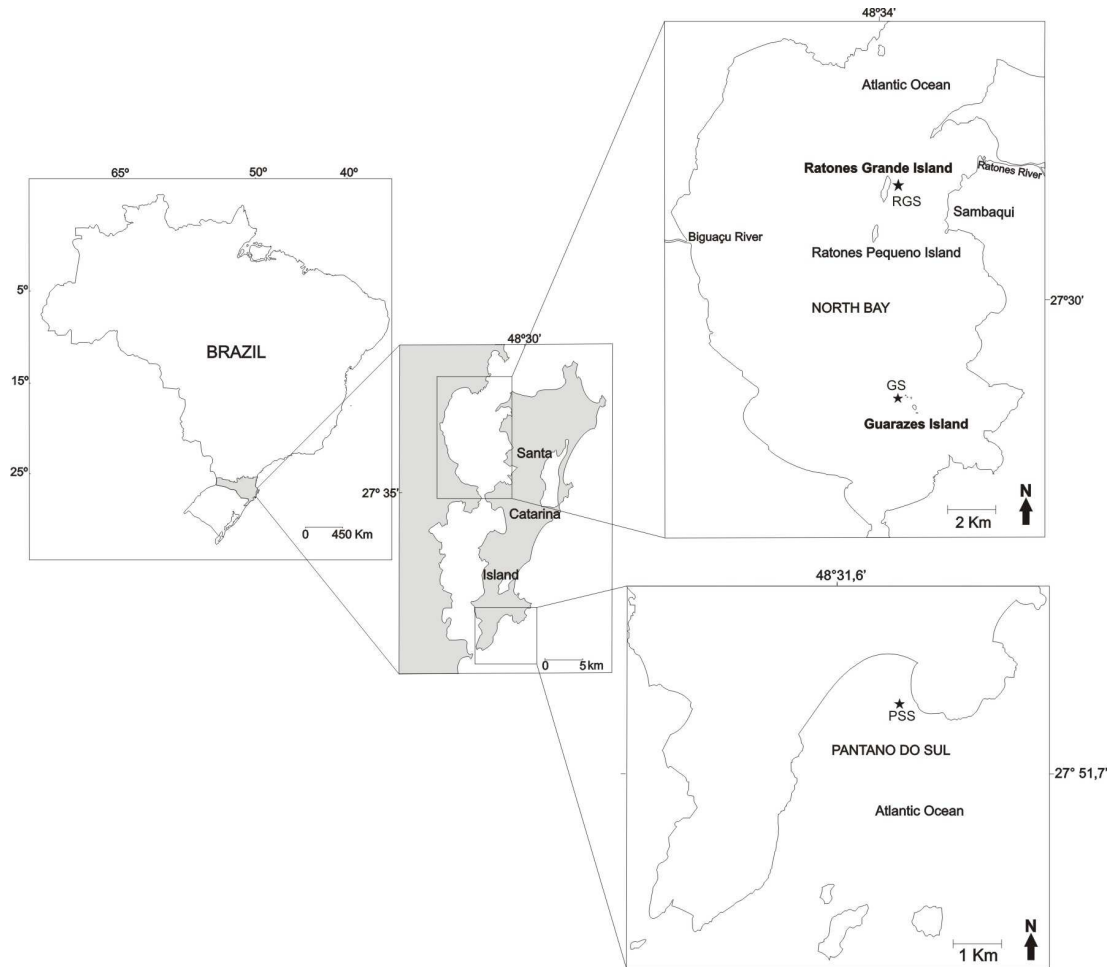


Fig. 1. Sampling sites location on the coast of Santa Catarina Island, South-Western Atlantic, Brazil. RGS: Ratones Grande Station; GS: Guarazes Station and PSS: Pantano do Sul Station.

The samples were prepared according to Simonsen (1974) and observed under a Scanning Electron Microscope (SEM) JEOL 6390 LV. Frustule measurements and photomicrography were taken with an Optical Microscope (OM) Olympus BX 50.

*Coscinodiscus wailesii* present radial striation and a central hialine area with irregular borders (Fig. 2a, 2d). The areolae size increases from the center to the margins, decreasing at the joint of the valve face with the mantle. They present a deep valve mantle and a right-angle between the mantle and the marginal area of the valve face (Fig. 2b). The cell diameter varied from 208  $\mu\text{m}$  (PSS in January/08) to 362.5  $\mu\text{m}$  (RGS in April/07). The average diameter was larger in autumn (301.5  $\mu\text{m}$ ) than in the summer (245.4  $\mu\text{m}$ ). The number of areolae varied from 4 to 6/10  $\mu\text{m}$  ( $n=71$ ). Two rimoportulae rings are located in the joint zone between the mantle and the valve face

and in the mantle's median region. The latter presents two macrorimoportulae (Fig. 2e) and there are also small rimoportulae scattered over the valve face (Figs. 2c, 2f). They were located at the end of some striae that rise in the central area (Fig. 2d). The central area was in accordance with the description given by Fernandes et al. (2001). The chloroplasts are discoid, numerous and irregularly distributed within the cell. There were also resting cells in the samples. According to Nagai et al. (1996) these are characterized by cytoplasm detached from the frustule and gathered in the central area of the cells. The occurrence of two distinct types of frustule diameters in the samples may indicate the presence of resting cells, which according to Nagai et al. (1996), produce smaller diameters than the vegetative cells.

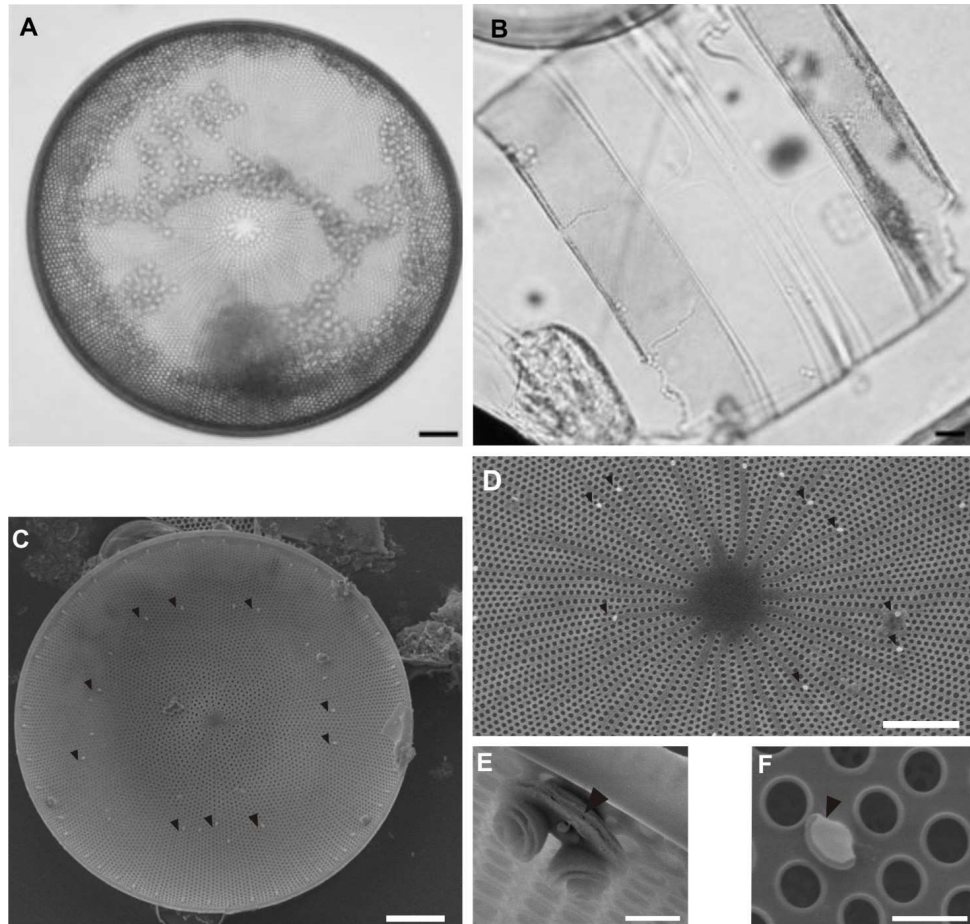


Fig. 2. Light microscopy images (Figs. A and B) and Scanning electron microscopy (Figs. C- F) of *Coscinodiscus walesii*. Fig. (A): valve view; Fig. (B): girdle view; Fig. (C): general valve view showing microrimoportulae scattered on the valve face (arrows). (D): central region with interstriae of varied sizes and microrimoportulae (arrows). (E): macrorimoportula, internal view (arrow). (F): valve face microrimoportula, internal view (arrow).

The frustule morphology of *Coscinodiscus walesii* accords with other descriptions of it (SCHMID; VOLCANI, 1983; HASLE; LANGE, 1992; FERNANDES et al., 2001). However, the diameter was closer to the limits registered by Fernandes et al. (2001) [195-385  $\mu\text{m}$ ] and did not attain the 500  $\mu\text{m}$  diameter cited by Schmid and Volcani (1983).

Figure 3 shows the distribution of *Coscinodiscus walesii* cell density as related to total phytoplankton cell density, water temperature and salinity, during the sampling periods. The total phytoplankton cell density varied from  $3,599.10^6$  to  $4,15.10^5$  cells.L<sup>-1</sup> at PSS (Fig. 3c, 3d) and from  $1,8891.10^7$  to  $2,193.10^6$  cells.L<sup>-1</sup> at RGS (Fig. 3a, 3b). For *Coscinodiscus walesii*, the highest growth periods were observed in April/2007 with  $2,316.10^3$  cels.L<sup>-1</sup> at RGS (Fig. 3a, 3b) and in January/2008 with  $1,158.10^3$  cels.L<sup>-1</sup> at PSS (Fig. 3a, 3b). It will be seen that no

growth of *Coscinodiscus walesii* occurred during the early winter and during spring. No *C. walesii* cells were found at GS in the quantitative analysis. Table 1 gives the abiotic water data at the three stations sampled.

These values are similar to those of the *C. walesii* blooms reported for Paranaguá Bay and surrounding areas (FERNANDES et al., 2001) and for the German coast (DÜRSELEN; RICK, 1999). On the Japanese coast, Nagai et al. (1996) registered blooms of  $10^2$  cells.L<sup>-1</sup>.

The present results indicate that *C. walesii* in Santa Catarina Island coastal waters has dynamics distinct from those present in Parana State (FERNANDES et al., 2001). There *C. walesii* was found in every month of the year and produced blooms sporadically in Paranaguá Bay (PR).

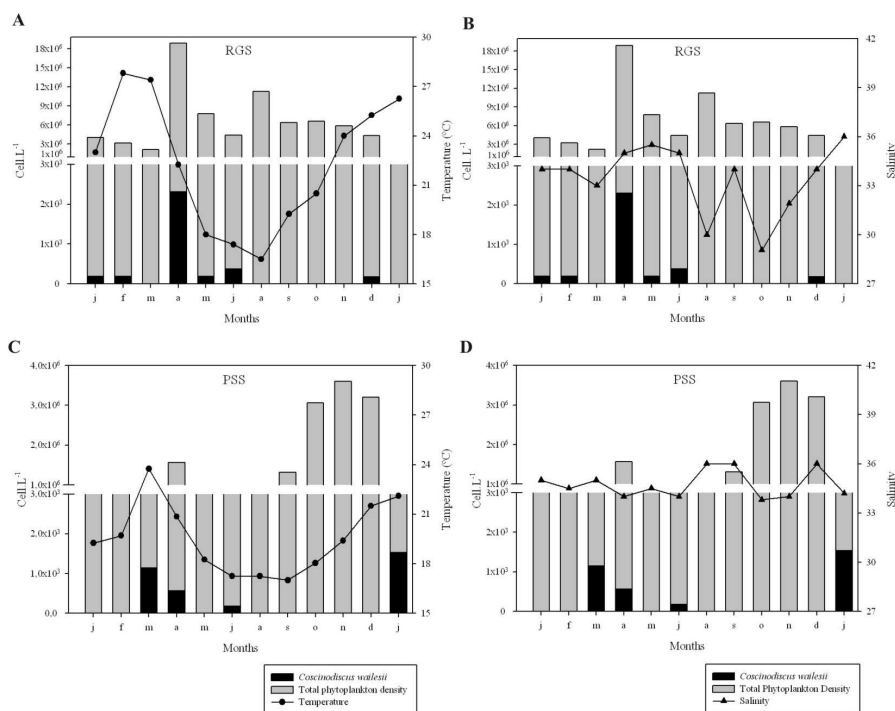


Fig. 3. *Coscinodiscus walesii* density (Cells.L<sup>-1</sup>) and abiotic factors at RGS and PSS, from January/2007 to January/2008.

Table 1. Temperature (T) and Salinity (S) of the, South-Western Atlantic, Brazil Ratonas Grande Station; GS: Guarazes Station; PSS: Pantano do Sul Station.

	RGS	GS	PSS
<b>2007</b>			
January	T: 23 °C S: 34	T: 23 °C S: 34	T: 19,25 °C S: 35
February	T: 27,8 °C S: 34	T: 28,2 °C S: 34	T: 19,7 °C S: 34,5
March	T: 27,3 °C S: 33	T: 27,8 °C S: 33	T: 23,75 °C S: 35
April	T: 22,25 °C S: 35	T: 22 °C S: 35,5	T: 20,85 °C S: 34
May	T: 18 °C S: 35,5	T: 17,8 °C S: 35	T: 18,25 °C S: 34,5
July	T: 17,4 °C S: 35,5	T: 17,5 °C S: 35	T: 17,25 °C S: 34
August	T: 16,5 °C S: 30	T: 16,5 °C S: 30	T: 17,25 °C S: 36
September	T: 19,25 °C S: 34	T: 19 °C S: 35	T: 17 °C S: 36
October	T: 20,5 °C S: 29,05	T: 21 °C S: 30,1	T: 18,05 °C S: 33,8
November	T: 24 °C S: 31,9 °C	T: 24,5 °C S: 32,1	T: 19,4 °C S: 34
December	T: 25,25 °C S: 34	T: 25,5 °C S: 34	T: 21,5 °C S: 36
<b>2008</b>			
January	T: 26,25 °C S: 33	T: 28 °C S: 33	T: 22,1 °C S: 34,2

Table 2 shows *Coscinodiscus walesii* density percentages as related to total phytoplankton density. The results indicate but a small contribution of *C. walesii* to total phytoplankton. The relative density of *C. walesii* was greater at PSS than at RGS. Nevertheless the discrepancy between *C. walesii* cell volume and the majority of the phytoplankters identified in the samples makes comparisons based on cell number unreal.

However, the discrepancy between *C. walesii* cell volume and that of the majority of the phytoplankters identified in the samples makes comparisons based on cell number of doubtful value.

The water temperature at the stations studied presented a variation of 11.3°C between the coldest and the warmest months at RGS and of 6.75°C at PSS. The salinity presented a greater variation at RGS (6.9) than at PSS. However, there were no significant positive correlations between *C. walesii* cell density and temperature or between cells density and salinity. The species occur over a broad temperature range, from 1°C to 30.9°C (NAGAI et al., 1996, DÜRSELEN; RICK, 1999; FERNANDES et al., 2001). We do not believe that the variation in salinity observed had any direct effect on population growth since the species is highly tolerant of salinity variations, from 8 to 35 psu (FERNANDES et al., 2001).

Table 2. Phytoplankton total density and *Coscinodiscus wailesii* relative density at RGS and PSS in the Santa Catarina Island, South-Western Atlantic, Brazil.

	RGS		PSS	
	Total Phytoplankton Cells.x10 <sup>3</sup> .L <sup>-1</sup>	% <i>C. wailesii</i>	Total Phytoplankton Cells.x10 <sup>3</sup> .L <sup>-1</sup>	% <i>C. wailesii</i>
<b>2007</b>				
January	4040	0,005	455	
February	3213	0,006	415	
March	2193		559	0,2
April	18891	0,01	1565	0,04
May	7774	0,003	692	0,04
July	4418	0,009	474	
August	11272		435	
September	6373		1312	
October	6590		3066	
November	5851		3599	
December	4377	0,004	3205	
<b>2008</b>				
January	118		229	0,7

Nagai et al. (1996) concluded that *C. wailesii* vegetative cells become resting cells that remain on the sediment when the water column is stratified. During turnover periods these cells may then re-enter the water column and, if the environmental conditions are favourable, grow to ensure the continuity of the life cycle (NAGAI et al., 1996; NISHIKAWA; YAMAGUCHI, 2008). Nagai et al. (1996) observed that the recurrence of autumn blooms depended on the number of resting cells in the sediment. In the Santa Catarina Island coastal waters, future studies on population dynamics of *C. wailesii* should be followed by investigations of the thermal and saline characteristics of the water column, nutrient analyses and quantification of vegetative and resting cells in the sediment. The quantification of the resting cells in the sediment is essential for monitoring programs, seeing that these data together with the abiotic data may be used to foresee the occurrence of blooms and thus make it possible for preventive actions against its noxious effects to be taken.

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