Skeletonema tropicum (*Bacillariophyceae*) present in Uruguayan southern coastal waters

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ABSTRACT - This is the first report of *Skeletonema tropicum* Cleve in Uruguayan coastal waters. Under scanning electronic microscopy the species showed convex valves, strongly silicified joined in colonies, with typical 1:1 junctions and occasionally 1:2. The species was found in tropical regions, but in our study in the Uruguayan coast, it was found between 11.1-12.7 ºC at 35º04'S-54º53'W**,** for this reason the geographical distribution and temperature r ange could be broadened.

Key words: diatom, Río de la Plata, Uruguay, Atlantic Ocean

RESUMO - ***Skeletonema tropicum* (*Bacillariophyceae*) presente em águas costeiras no do sul do Uruguai.** Este é o primeiro relato de *Skeletonema tropicum* Cleve na costa do Uruguai. A espécie mostrou por meio da microscopia eletrônica de varredura, valvas convexas, fortemente silicosas agrupadas em colônias, com junções típicas 1:1 e ocasionais 1:2. A espécie foi encontrada em regiões tropicais, no entanto, em nosso estudo na costa uruguaia a mesma foi encontrada em temperaturas entre 11.1-12.7 ºC, a 35º 04´S - 54º 53´W, razão pela qual a distribuição geográfica e faixa de temperatura pode ser ampliada.

Palavras-chave: diatomácea, Rio de la Plata, Uruguai, Oceano Atlântico

INTRODUCTION

The phytoplankton species have economic and scientific importance as indicators of water masses with different physical and chemical characteristics (Sarno *et al*., 2005). The genus *Skeletonema* Greville is considered to be one of the most abundant coastal marine diatoms. The determination to the species level is difficult when using light microscopy, because diacritic structures are not visible in their valves, hampering reliable identification. For this reason, different taxonomists report *S. costatum* Greville (Cleve) as the only species of *Skeletonema,* and as Hasle (1973) wrote, "for the most marine phytoplanktologist the name of *Skeletonema* is synonymous of *Skeletonema costatum*". Until Sarno *et al*. (2005) the great diversity within the genus *Skeletonema* was relatively unknown and due to its easy culturing and adaptability to different conditions, the species *Skeletonema costatum* (Greville) Cleve is utilized for different biological disciplines in scientific research, even with the implicit assumption that all strains and populations are part of single species (Sarno *et al*., 2005).

In Uruguay, different studies reported *S. costatum* as the only species of this genus present in the Uruguayan marine plankton (Ferrando, 1962; Baysée *et al*., 1986; Elgue *et al*., 1990; Ferrari & Méndez, 2000; Ferrari & Pérez, 2002).

The study area comprised the external zone of Río de la Plata and Uruguayan coastal waters. This environment has particular physicochemical and biological characteristics, in which several species from different water masses occur, being a mixing zone between brackish and subtropical and sub-Antarctic oceanic waters (Boltovskoy *et*

al. 1999). The external region is an estuarine zone characterized by a wide frontal zone with both turbidity and salinity fronts (Framiñan & Brown, 1996; Nagy *et al*., 1997).

The main path of Río de la Plata flows north-northeastern along the Uruguayan coast. Coastal waters defined by salinities under 32 psu (Guerrero & Piola, 1997) are dominated by the Río de la Plata estuary and its influence spreads along the external shelf.

In this study we analysed the ultrastructure of *Skeletonema* specimens collected off the Uruguayan coast with the aim to identify the species present in the area.

MATERIAL AND METHODS

Seawater samples were collected in August 2002 during the "Anchoita 03/2002" cruise aboard the Uruguayan oceanographic vessel B/I Aldebarán. Stations 1 to 3 were located in the Río de la Plata, while stations 4 to 8 were in Uruguayan coastal waters (Fig. 1).

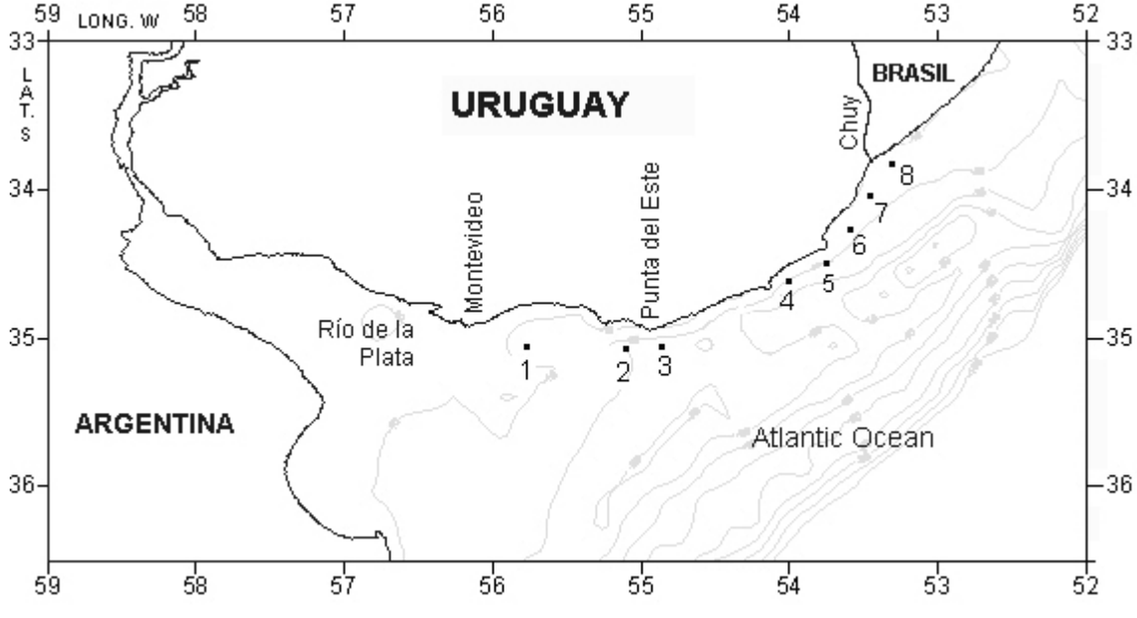

Fig. 1. Sampling area in the Uruguayan coast showing the sampling stations 1 to 8.

Phytoplankton samples were collected with a 25 µm plankton net and fixed with neutral formaldehyde 4%. Salinity and temperature were measured *in situ* with a YSI 30/10 FT salinometer and a mercury thermometer with a precision +/- 0.5 ºC. After fixation, samples were treated with acid (1:1:4; sample; HNO_3; H_2SO_4), boiled for few seconds, and then washed with distilled water and following successive centrifugation steps (3500 rpm/10 min). Permanents slides were prepared by mounting the clean dry material in Naphrax. Light microscope observations were made with a Leica microscope model DMLA equipped with Nomarski differential interference contrast and phase contrast using magnification of 1000x. Light photo micrographs were taken using a Canon E05D60 digital camera, at the Instituto Español de Oceanografía, Vigo-España. For scanning electron microscopy a drop of acid cleaned material was mounted on stubs, sputter coated with gold-palladium, and observed using an scanning electron microscope Phillips Model XL30 at the Centro de Apoyo Cientifico y de Tareas de Investigación of the University of Vigo-España.

RESULTS AND DISCUSSION

The specimens observed under SEM showed strongly silicified convex frustules joined in colonies. The cell diameter was between 5.1 to 15.6

µm. Sarno *et al*. (2005) reported cells up to 17.5 µm in samples from the Gulf of Naples. According to the description of Sarno *et al*. (2005) the morphology of all *Skeletonema* specimens examined in this work matched with the description of *Skeletonema tropicum* Cleve.

Small cells were observed with Nomarski differential interference contrast and phase contrast (Figs. 2, 3). The intercalary fultoportula processes (IFP) showed a longitudinal split with an elongated opening at the base of the tube that connects the next cell with a knuckle-like junction. In our samples the most common junctions are of the 1:1 type but few cells with a 1:2 junction with contiguous connections as a zigzag line were also found. The distance between IFP was approximately 1µm and there were 8-9 IFPs in a 10µm section (Figs. 5, 8). According to Sarno *et al*. (2005) we found a short (1µm long) intercalary rimoportula near the ring of IFPs, morphological feature characterizing this species by Sarno *et al*. (2005).

In this study, two water masses were found, for St. 1-2-3, the salinity was between 22.7 – 29.9 psu and the temperature was 10.7 – 11.8 ºC. For stations 4 to 8, the salinity was between 18.9 – 30.5 and the temperature was 11.1 – 12.7 ºC (Tab.1). Oceanographic data showed a strong oceanic cold water influence constraining the Río de la Plata's discharge plume close to the coast. Eastward, waters with higher temperature were observed corresponding with the thermal characteristic of the ones observed in the outer Río de la Plata (González-Piana & Ferrari, 2005).

TABLE 1 - Salinity and temperature (ºC) for the eight stations in August 2002.

Stations	1	2	3	4	5	6	7	8
Salinity	24.4	29.9	22.7	30.5	21.1	18.9	19.9	23.9
Temperature (ºC)	11.5	10.7	11.1	11.1	11.8	12.1	12.7	12.5

According to Hulburth & Guillard (1968) *S. tropicum* is a tropical and subtropical species, with a distribution not beyond 30º North of equator, in the western Atlantic Ocean. However, the species was recently reported at 32º in the South Atlantic Ocean on the Río Grande coast, Brazil (Bergesch *et al*., 2006). In our studies we found live cells of *S. tropicum* with chloroplast at 11.1 ºC in the station 3 (35º04´S-54º53´W) off Punta del Este. Another author found that the species disappeared in Japanese coastal waters in early winter, when the water temperature fell bellow 12 ºC (Ueno 1993).

Furthermore, we did not detect the presence of *S. costatum* in our samples, although it is reported as a common species in this estuarine marine region. Hence, it will be necessary to re-examine old material or perform additional surveys in a larger geographic area with the aim of verifying the presence of *S. costatum*.

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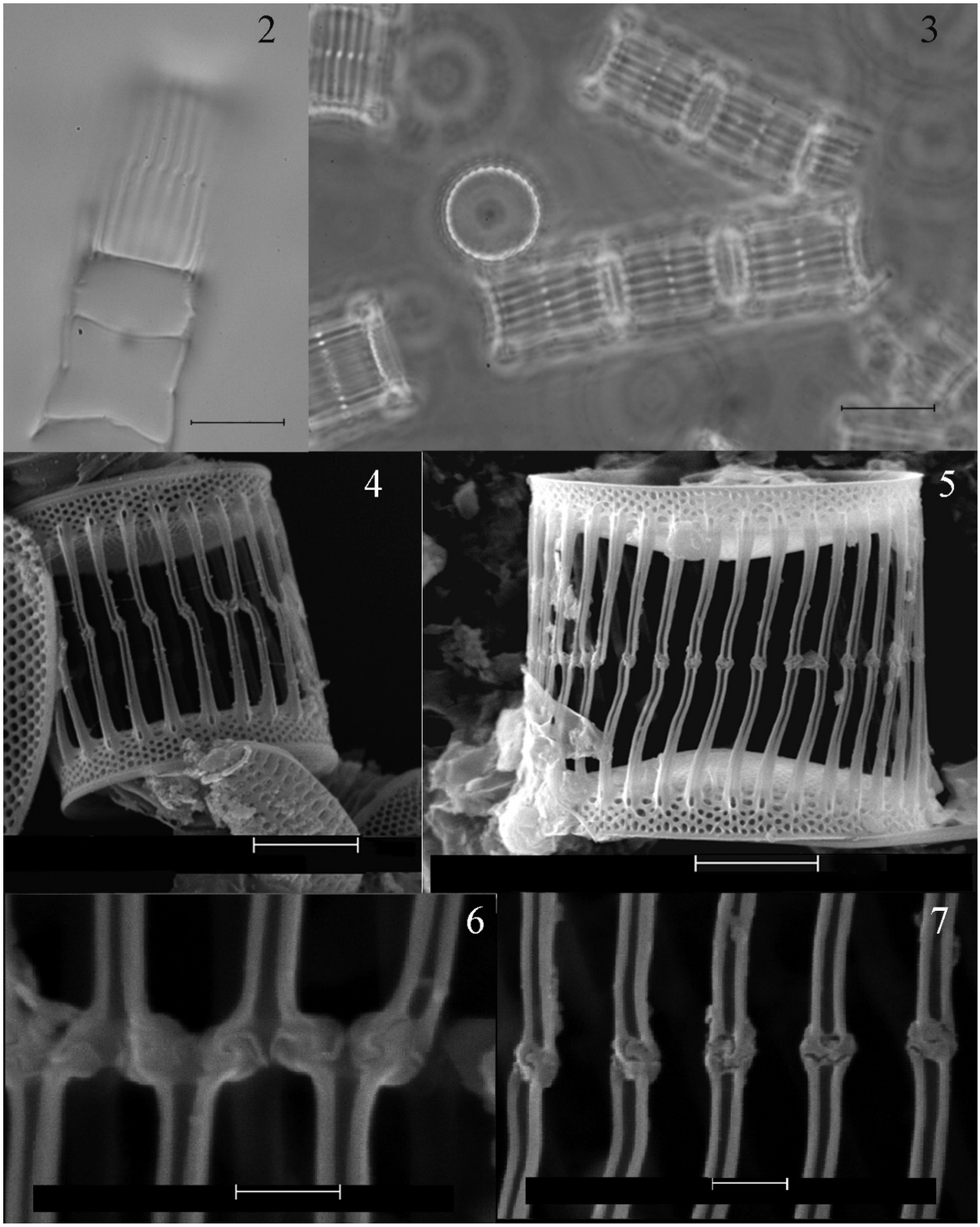

Figs. 2 - 7. *Skeletonema tropicum* from Uruguay. **2.** Frustule showing 1:1 junction, (Nomarski contrast). **3.** Frustule in phase contrast. **4**. Intercalary valves with 1:1 **-** junctions **5.** Intercalary valves with 1:2 junctions. **6.** Detail of 1:2 junctions. **7.** Detail of 1:1 junctions. Scale bars: **Figs. 2, 3** = 10 µm (LM); **4, 5** = 5µm (SEM); **Figs. 6, 7** = 1µm (SEM).