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Thalassiosira rotula, a heterotypic synonym of *Thalassiosira gravida*: morphological evidence

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Colonies that could be identified as *Thalassiosira rotula*, others that could be identified as *Thalassiosira gravida* and colonies with a mixture of the valve structures of these two species were found coexisting in the same samples from Piedras Coloradas (40°50′46″S, 65°06′18″W). Net samples were collected from surface water at several stations in the northern area of San Matías Gulf in the Río Negro Province, Argentina, from April 1998 to May 2000 and from March 2006 to April 2007. Untreated and cleaned diatom samples were examined using light and scanning electron microscopy. The differential features used to distinguish *T. rotula* and *T. gravida* were discussed and refuted with morphological evidence. Based on this analysis, both taxa are assumed to be conspecific by sharing fultoportulae pattern and morphology of the cingulum. Thus, the name of the species must be *T. gravida* by the principle of priority. A revision of the original material of *T. gravida* from Baffin Bay was carried out with light microscopy. The original figure 14 was designated as lectotype and the slide no. 64 of the Tempère and Peragallo Collection (2nd edition) curated at the Muséum National d'Histoire Naturelle in Paris was designated as epitype.

Keywords: Thalassiosira gravida, Thalassiosira rotula, *lectotype, epitype, morphological analysis*

Cleve (1896) described *Thalassiosira gravida* from Baffin Bay, based on plankton material, without designating the holotype or mentioning the type locality. It was impossible to determine in which of the 50 samples collected by Nielsson and studied by Cleve if species was present. Cleve (1896) characterized *T. gravida* as showing valves almost flat, with numerous fultoportulae irregularly scattered and areolae arranged in radiate rows, and commented in the protologue that the resting spores of this species are identical to *Coscinodiscus subglobosus* Cleve & Grunow.

Later, Meunier (1910) described *Thalassiosira rotula* and mentioned that this new species was very common in Belgian waters and very rare in the area of the Novaya Zemblya, Barents and Kara seas. Meunier commented that the rare specimens found in the Kara Sea were probably introduced as contaminants from a pipette previously used with samples from Belgian coastal waters where the species had been identified earlier as *T. gravida* by him. According to the protologue, *T. rotula* differs from *T. gravida* by frustules with shorter pervalvar axis, cingulum with an unevenly thickened band and resting spores that were never found. Meunier pointed out that the species is probably not boreal and he did not designate a holotype or establish the type locality.

The modern concept of *Thalassiosira* Cleve was established by Hasle (1973) who amended its description, clarifying the generic limits; the diagnostic features distinguishing species within the genus had been proposed earlier and discussed by Hasle (1968) and Hasle et al. (1971). Hasle (1968) examined 20 species of *Thalassiosira* using light and electron microscopy and determined that the structure and arrangement of the valve fultoportulae were the striking features used to distinguish them. Her analysis included *T. gravida* and *T. rotula*, which showed the same pattern of fultoportulae. Subsequently, Hasle et al. (1971) found some valves with the structure of *T. gravida* in clonal cultures of *T. rotula*. Hasle et al. (1971) suggested that there is a relationship between the areola pattern and the silicon available in the culture.

Syvertsen (1977), in his comprehensive study of the ecology and morphology of *T. rotula* and *T. gravida*, listed five features that seem to distinguish both species: (1) the structure of the valve, with radial ribs in *T. rotula* and radial rows of areolae in *T. gravida*; (2) the unevenly thickened band present in *T. rotula* described as differential feature of this species by Meunier (1910); (3) the length of the pervalvar axis, shorter in *T. rotula* than in *T. gravida*; (4) the production of resting spores in *T. gravida*, never reported in *T. rotula*; and (5) the distribution of *T. rotula* in warm to temperate seas as opposed to a polar environment for *T. gravida* (Hasle 1976, Semina 2003).

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Syvertsen (1977) also carried out some experiments with strains of *T. rotula* and *T. gravida* cultured at different temperatures and silicon concentrations, and established that the valve structure was basically determined by the temperature and the unevenly thickened band in *T. rotula* was determined by nitrogen and phosphorus deficiency. In addition, Hasle & Syvertsen (1997), based on Syvertsen (1979), pointed out that the resting spores described by Cleve (1896) for *T. gravida* correspond to *T. antarctica* Comber.

The aims of this article are to document morphological features of *T. rotula* and *T. gravida* in the area of San Matías Gulf, to compare both species with their type materials if available, to discuss the striking features that distinguish each species and to propose any necessary taxonomic changes.

Materials and methods

According to Stafleu & Cowan (1981), the original material of *T. rotula* and the Meunier Collection are unknown. In addition, Fryxell (1975a) and de Wolf & Sterrenburg (2003) did not mention the Meunier Collection and several curators and contacts in European herbaria gave us negative answers about the existence of this collection in their institutions.

The only material of *T. gravida* from Baffin Bay belonging to the Cleve's Collection was found in the Tempére and Peragallo Collection (2nd edition), curated at the Herbarium of the División Ficología of the Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata. Slide no. 64 of this collection was examined with light microscopy. No sample corresponding to this material on slide no. 64 was found in the Tempère and Peragallo Collection curated at the Centre de Recherches sur la Paléobiodiversité et les Paléoenvironnements of the Muséum National d'Histoire Naturelle in Paris.

Material from coastal waters of San Matías Gulf in the Río Negro Province was collected at several stations in the northern area: Punta Orengo, Las Garzas, Banco Reparo, San Antonio Oeste, Los Álamos, Las Grutas, Piedras Coloradas, El Sótano and El Fuerte (Fig. 1) from April 1998 to May 2000 and from March 2006 to April 2007. Seawater temperature in this area ranges

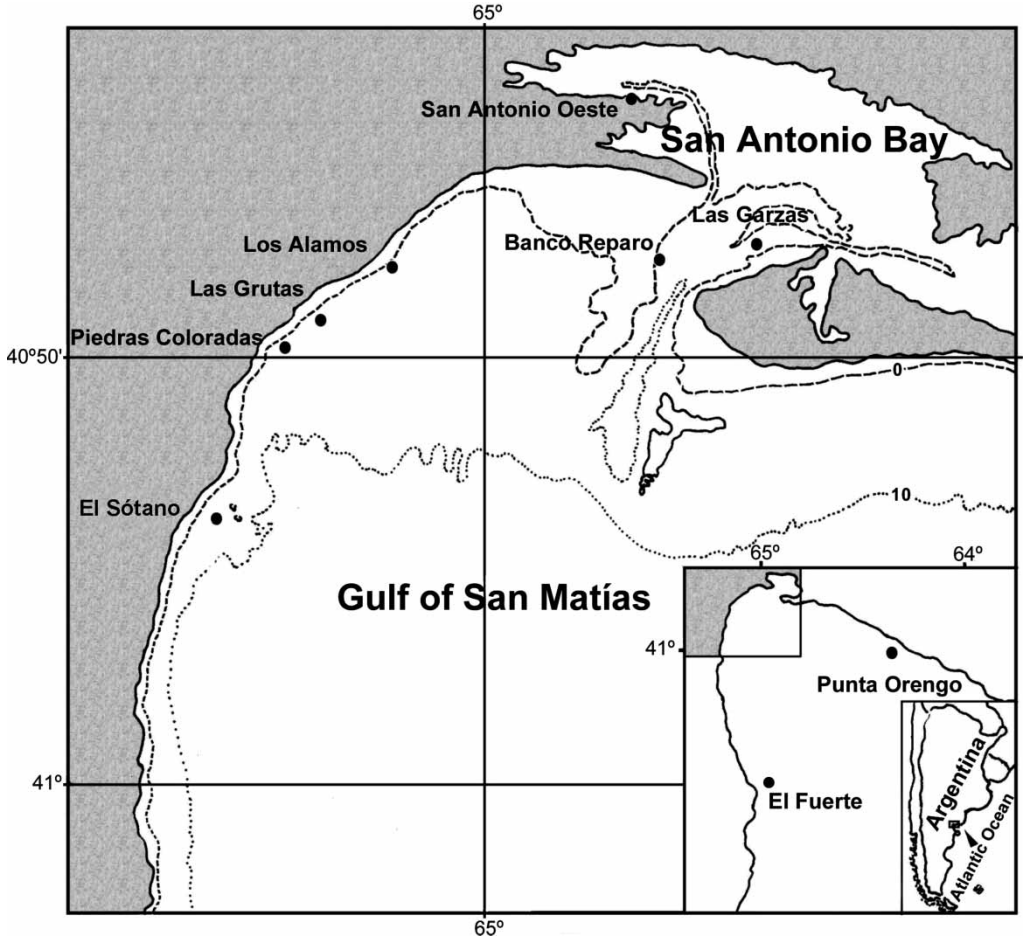


Fig. 1. Map of the northern region of the San Matías Gulf showing the nine sampling stations and locations in the study area of Argentina: Punta Orengo, Las Garzas, Banco Reparo, San Antonio Oeste, Los Álamos, Las Grutas, Piedras Coloradas, El Sótano, and El Fuerte.

from 7 to 23.5 °C, and salinity from 34 to 36 (Pascual et al. 2001).

Qualitative samples were collected from the surface water (between 0 and 5 m) with a 30 μm mesh-size net and were fixed in 4% formalin. In the laboratory, the preserved samples were rinsed with distilled water to remove salt and preservatives, and the organic matter was oxidized according to Hasle & Fryxell (1970) and Prygiel & Coste (2000). The untreated and cleaned materials were mounted for light and scanning electron microscopy according to Ferrario et al. (1995). Permanent slides were made with Hyrax or Naphrax.

A total of 96 samples were analyzed and the material was deposited in the Herbarium of the División Ficología, under the numbers LPC 4550 to 4643, LPC 13648 to 13685.

Observations were made using Nikon Microphot-FX microscope under phase contrast optic and Leica DM 2500 microscope under differential interference contrast optic. The photomicrophotographs were obtained using a Leica DM 2500 microscope and scanning electron microscope Jeol JSM 6360 LV.

Diatom terminology followed: von Stosch (1975), Ross et al. (1979), Fryxell et al. (1981), Round et al. (1990) and Hasle & Syvertsen (1997).

Results

Analysis of the protologue of Thalassiosira rotula

The protologue of *T. rotula* includes a comprehensive description of the differential features and sharp illustrations (Meunier 1910, figs 67–70, reproduced here in Fig. 2). Meunier's fig. 67 shows a colony with flattened and discoid cells connected by a thick thread that denotes the presence of a central cluster of fultoportulae, and unevenly thickened bands (see fig. 70). In valve view, the cell shows radial ribs on the valve surface and striae on the valve mantle (Meunier's fig. 68) and the cleaned valve shows the scattered fultoportulae (Meunier's fig. 69). To date, the modern concept of *T. rotula* presented by Hasle et al. (1971), Syvertsen (1979), Sancetta (1990), Harris et al. (1995) and Hasle & Syvertsen (1997), among others, has followed Meunier's (1910) concept with new terminology and more details. Because Meunier's Collection is presumed inexistant, the concept of the species should be interpreted from the original figures.

In reference to the distribution of the species, Meunier (1910) pointed out in the protologue that *T. rotula* is very common in the Belgian waters and is very rare in the areas of the Novaya Zemblya, Barents and Kara seas. In addition, Meunier (1910) recognized that he also found *T. gravida* in Belgian coastal waters but it was extremely rare. Despite this fact, Meunier (1915) pointed out that *T. rotula* is 'caractéristique du microplankton de la Mer Flamande. . .' and added in reference to *T. gravida* 'Cette . . . espèce est étrangère à nos eaux'. Nevertheless, it is clear that he found *T. rotula* in the Barents and Kara seas and *T. gravida* in Belgian coastal waters.

Analysis of Cleve's material of Thalassiosira gravida

The protologue includes a comprehensive description and three line drawings of *T. gravida* (Cleve 1896, figs 14–16). Cleve's fig. 14 (reproduced here in Fig. 4) shows the distribution of fultoportulae of the species and Cleve's description reads: 'Cells coherent by a central thread, in sagittal view with quadrate outline. . . Valves almost flat, with numerous and irregularly arranged small spines near the margin. . . Structure: fine puncta arranged in rows, radiate from the centre (where there is a cluster of small, irregular puncta) to the periphery. . .'. To date, the modern concept of *T. gravida* presented by Hasle (1976), Sancetta (1990), Harris et al. (1995), and Hasle & Syvertsen (1997), among others, has followed Cleve's (1896) concept with new terminology and more details.

Taking into account that Cleve (1896) did not mention the type locality or which of the 50 samples the species comes from, and considering there is only one sample from Baffin Bay, it was not possible to determine whether slide no. 64 of the Tempère and Peragallo Collection could be considered a syntype. Slide no. 64 (Fig. 3) was analyzed and some specimens were found, one of which (Fig. 5) matching perfectly Cleve's (1896) description and his fig. 14.

Analysis of material from the northern area of San Matías Gulf

Thalassiosira rotula was previously reported from San Matías Gulf by Sar (1996), Sar et al. (2002) and Sunesen et al. (2009), whereas *T. gravida* has never been recorded in the San Matías Gulf. Nevertheless, in two water samples (LPC 13675 and LPC 13677) collected in late winter from

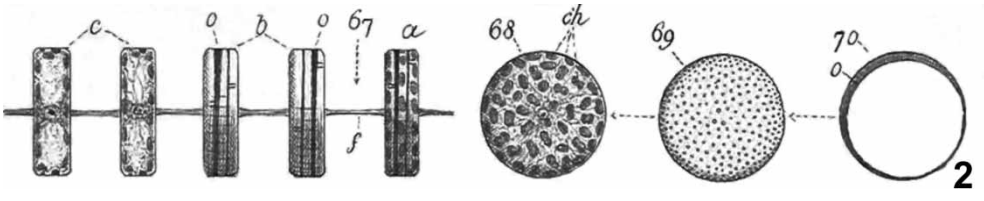
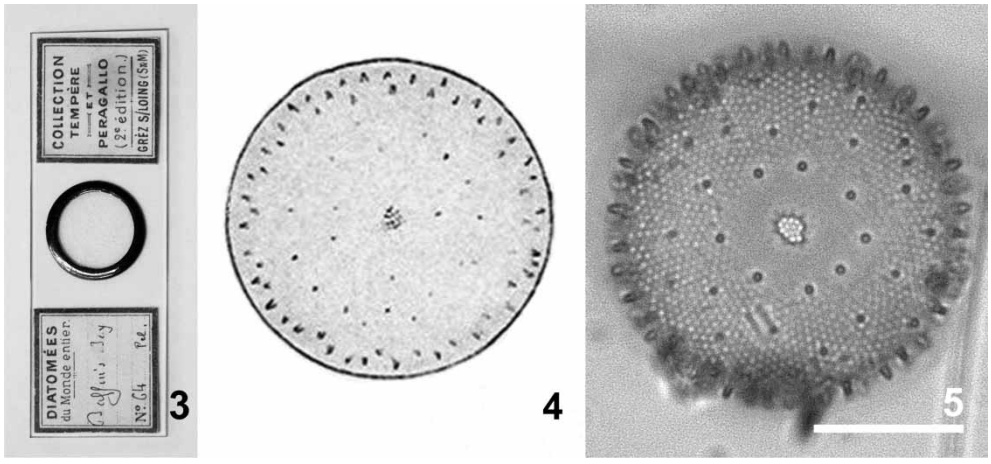
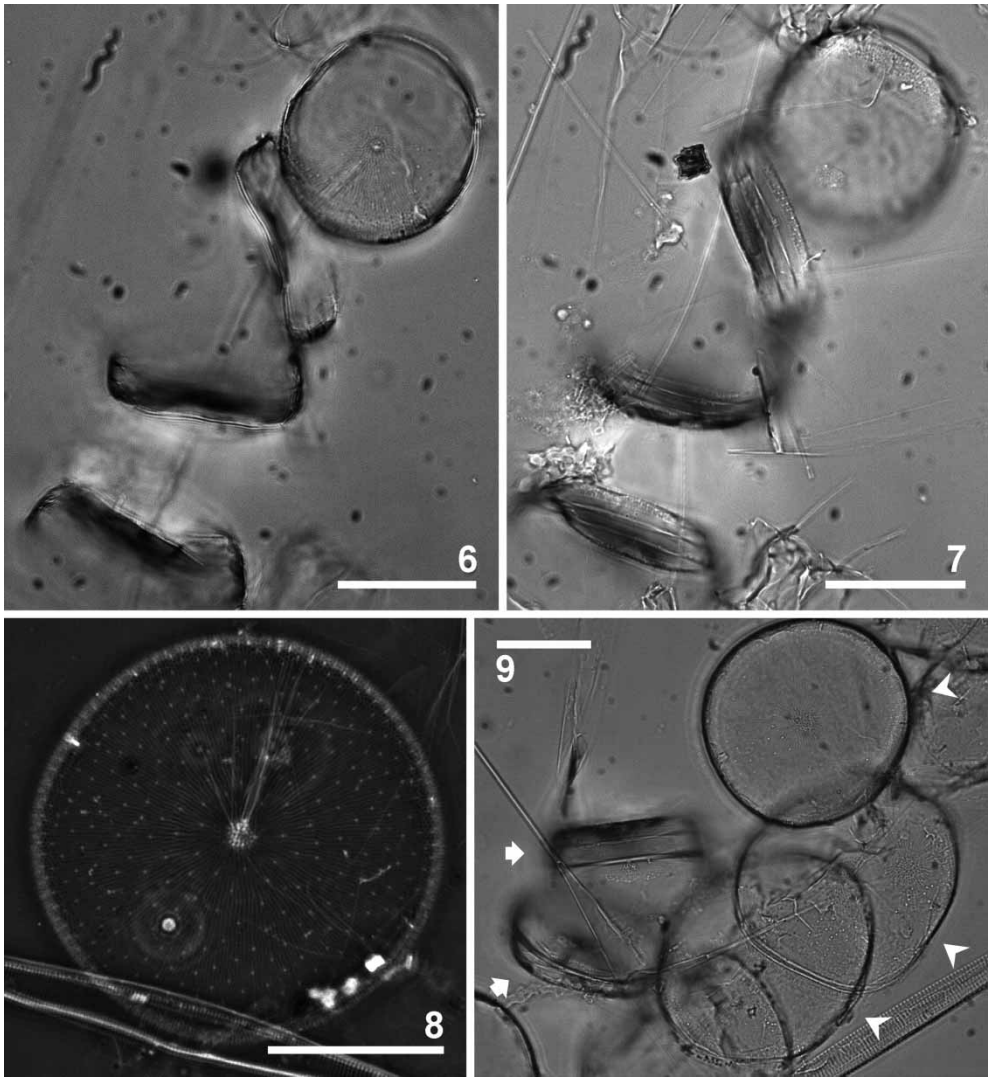


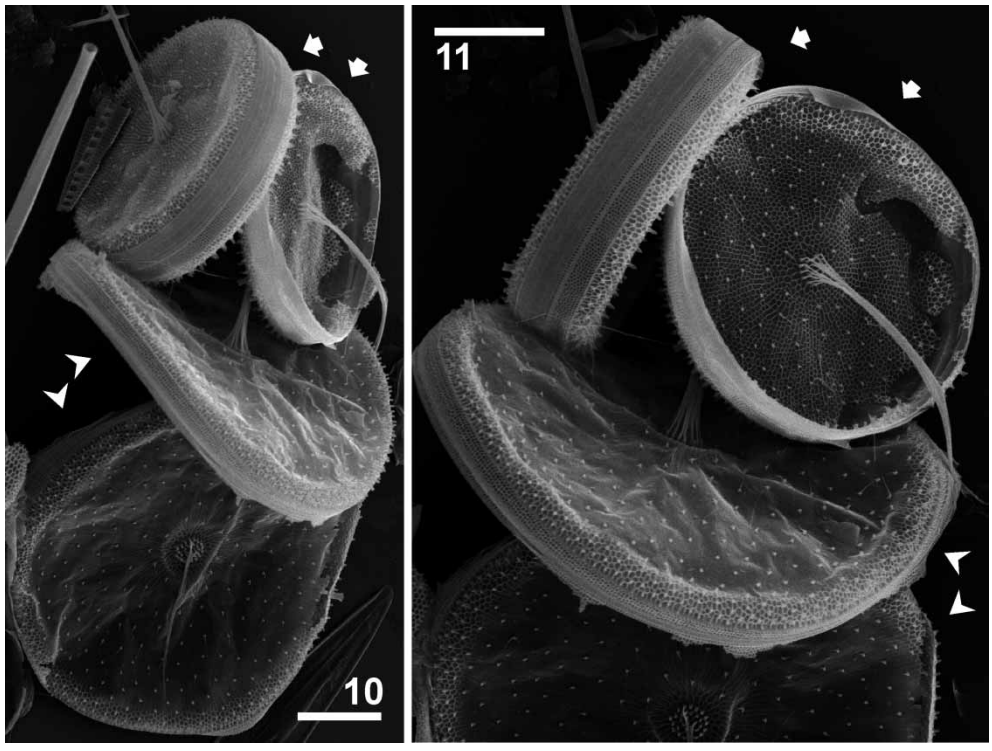
Fig. 2. Original illustrations (figs 67–70) of *Thalassiosira rotula* from Meunier (1910).



Figs 3–5. *Thalassiosira gravida*. Cleve's material. **Fig. 3.** Slide no. 64 from Baffin Bay of the Tempère and Peragallo Collection (2nd edition), curated at the División Ficología, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata. **Fig. 4.** Original illustration of a valve from Cleve (1896). **Fig. 5.** Epitype specimen of *T. gravida* in LM from slide no. 64 of the Tempère and Peragallo Collection (2nd edition). Scale bar = 10 μm.



Figs 6–9. *Thalassiosira rotula.* LPC 13675. LM. **Figs 6–7.** Different focuses of the same colony. **Fig. 6.** Cell in valve view with thick threads secreted by the central cluster of fultoportulae. **Fig. 7.** Note the first copula of the cingulum unevenly thickened. **Fig. 8.** General aspect of the valve. **Fig. 9.** *Thalassiosira rotula* (arrowheads) and *T. gravida* (arrows). Note the first copula of the cingulum unevenly thickened in cells of both colonies. Scale bars = 10 μm.



Figs 10–11. *Thalassiosira rotula* (arrowheads) and *T. gravida* (arrows). LPC 13675. SEM. Same cells in different position and magnification. Scale bars = 10 μm.

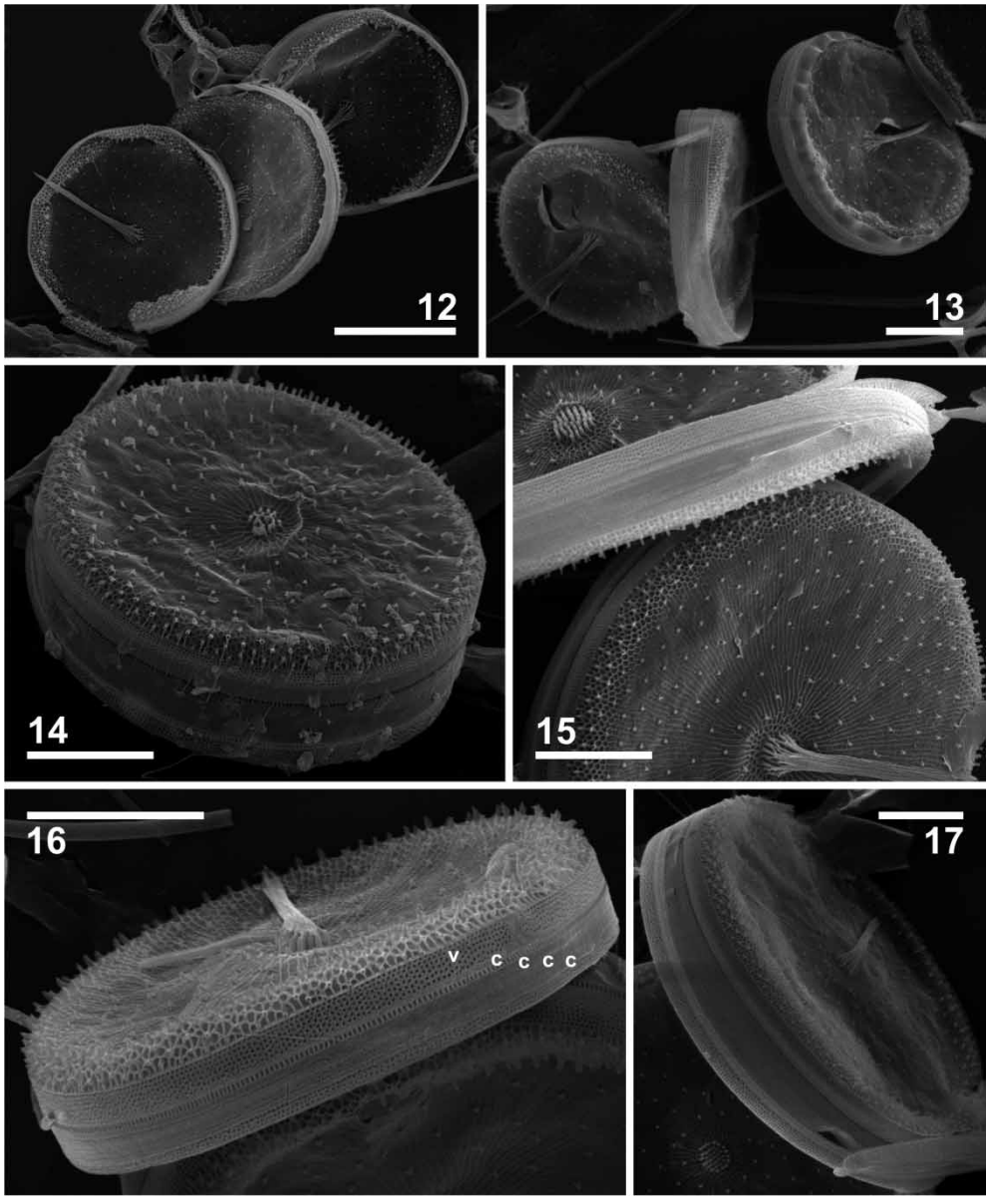
Piedras Coloradas, some *Thalassiosira* colonies were identified as *T. rotula* and *T. gravida*. Colonies with unequal valves in contiguous cells were frequently observed in the same sample, some valves were similar to *T. rotula* while others were identical to *T. gravida*. In addition, some valves were intermediate between *T. rotula* and *T. gravida*.

Typical specimens of *T. rotula* (Figs 6–17) present cells that are disc-shaped (Figs 10–11) or shortly cylindrical (Fig. 14), held together by several threads secreted by a central cluster of fultoportulae (Figs 12–13). The valve is circular, weakly silicified, with radial ribs on most of the valve surface and with areolae around the central cluster of fultoportulae and toward the valve mantle (Figs 14–15). The areolae are opened outwardly by large foramina in shallow chambers. The scattered fultoportulae are always placed on the ribs and the marginal ones on the angles of the areolae (Figs 15–16). The fultoportulae and the single rimoportula bear external tubes. The marginal fultoportulae form approximately five rings placed between the margin of the valve surface and the margin of the valve mantle, and they are slightly longer than the scattered ones with obliquely cut tubes (Fig. 16). The tube of the rimoportula is more prominent than those of the fultoportulae and it is placed between the valve face and mantle (Figs 8, 13–16). The cingulum is composed of five open bands, with the openings arranged in a dextral spiral (Fig. 16). The valvocopula is wide with areolae ordered in pervalvar rows (Figs 14, 16v, 17), the first copula is largely ligulate and presents one row of coarse poroids (Fig. 16c), and the other three copulae are narrow and non-porous (Fig. 16c). The first copula is sometimes unevenly thickened (Figs 7, 9, 14, 17).

Cells with this morphological pattern were scarce in fall, winter and spring in Punta Orengo, Las Garzas, Banco Reparo, Los Álamos, Las Grutas, Piedras Coloradas, El Sótano and El Fuerte.

Morphometric data: diameter 25–48 μm; length of the pervalvar axis 7–13 μm; radial ribs on the marginal region of the valve surface 17–23 in 10 μm; striae on the valve mantle 19–21.5 in 10 μm; areolae on the valve mantle 16–19 in 10 μm; marginal fultoportulae 6.5–10 in 10 μm; striae on the valvocopula 33–41 in 10 μm; areolae on the valvocopula 3–5 in 1 μm; areolae on the first copula 39–40 in 10 μm.

Typical specimens of *T. gravida* (Figs 10–11, 18–27) present cells that are shortly cylindrical, held together in colony by threads secreted by the central cluster of fultoportulae as in *T. rotula* (Figs 18, 21). The *T. gravida* valve is circular, with radial rows of areolae on the valve surface and mantle (Figs 10–11, 20–22), similar to the specimen found in slide no. 64 from Baffin Bay (Fig. 5). The areolae are opened outwardly by large foramina in chambers slightly deeper than those of typical *T. rotula* (Figs 23–24, 27). The scattered fultoportulae are always placed on the angles of the areolae (Figs 21–24, 27). The organization of the fultoportulae and rimoportula is the same as in *T. rotula* (Figs 21–22) and the morphology of the cingulum



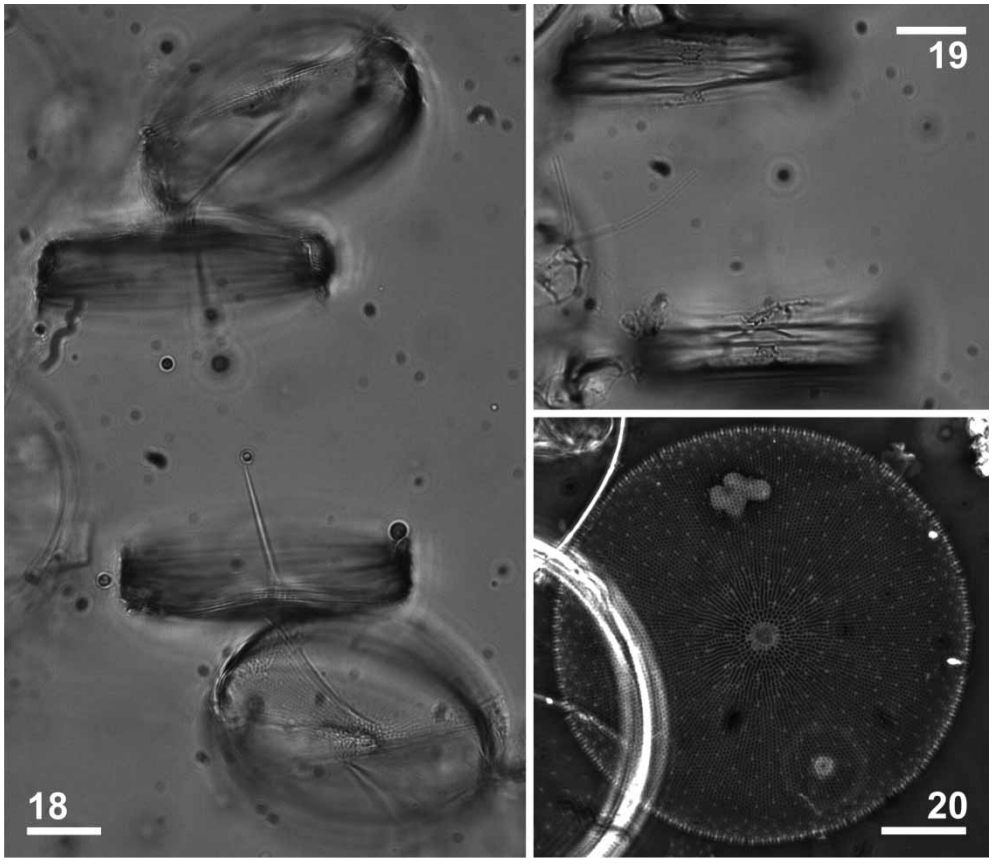
Figs 12–17. *Thalassiosira rotula*. LPC 13675. SEM. **Figs 12–13.** Colonies showing disc-shaped cells shortly cylindrical. **Fig. 14.** Frustule in tilted view showing fultoportulae and the cingulum. **Fig. 15.** Valve showing the organization of fultoportulae and one large rimoportula. **Fig. 16.** Frustule in tilted view to show the cingulum with open valvocopula (v), first copula largely ligulate (c) and three non-porous copulae (c). Note the band openings arranged in dextral spiral. **Fig. 17.** Frustule in tilted view showing the cingulum. Note both first copulae unevenly thickened. Scale bars = 20 μm (Fig. 12); 10 μm (Figs 13–17).

also coincides (Fig. 26). Some specimens show the first copula unevenly thickened (Fig. 25), similar to *T. rotula*.

Cells with this morphological pattern were found in late winter from Piedras Coloradas (LPC 13675, 1 September 2006; LPC 13677, 19 September 2006).

Morphometric data: diameter 30–44 μm; length of the pervalvar axis 8–12 μm; striae on the valve mantle 19–24 in 10 μm; areolae on the valve mantle 18–20 in 10 μm; marginal fultoportulae 6–10 in 10 μm; striae on the valvocopula 32–35 in 10 μm; areolae on the valvocopula 3.5 in 1 μm; areolae on the first copula 30–40 in 10 μm.

Some colonies showed unequal valves in contiguous cells (Figs 28–37). The colony illustrated in Fig. 28 presents two cells in opposite ends of the colony where the valves are like those in *T. gravida*, while the middle cell of the colony shows a valve similar to those in *T. rotula*. Similarly, the colony illustrated in Fig. 31 presents two valves like those in *T. gravida* and two like those in *T. rotula*. However, the valves similar to *T. gravida* have short areas without tangential walls of the areolae (Figs 30, 32–33). These types of valves resemble the coarse valve with well-developed areolae described by Hasle et al. (1971) from a culture of *T. rotula* and



Figs 18–20. *Thalassiosira gravida*. LPC 13675. LM. **Fig. 18.** Note cell in valve view and thick threads secreted by the central cluster of fultoportulae. **Fig. 19.** Two cells of a colony showing the first copulae of the cingulum unevenly thickened. **Fig. 20.** General aspect of the valve. Scale bars = 10 μm (Figs 18–19); 5 μm (Fig. 20).

considered by these authors to be structurally identical to *T. gravida*.

In addition, some colonies showed a cell with a valve identical to *T. rotula* and the contiguous cell with valve intermediate between *T. rotula* and *T. gravida* (Figs 34–35) while other colonies showed a cell with a valve similar to *T. gravida* and the contiguous cell with a valve intermediate between both species (Fig. 37).

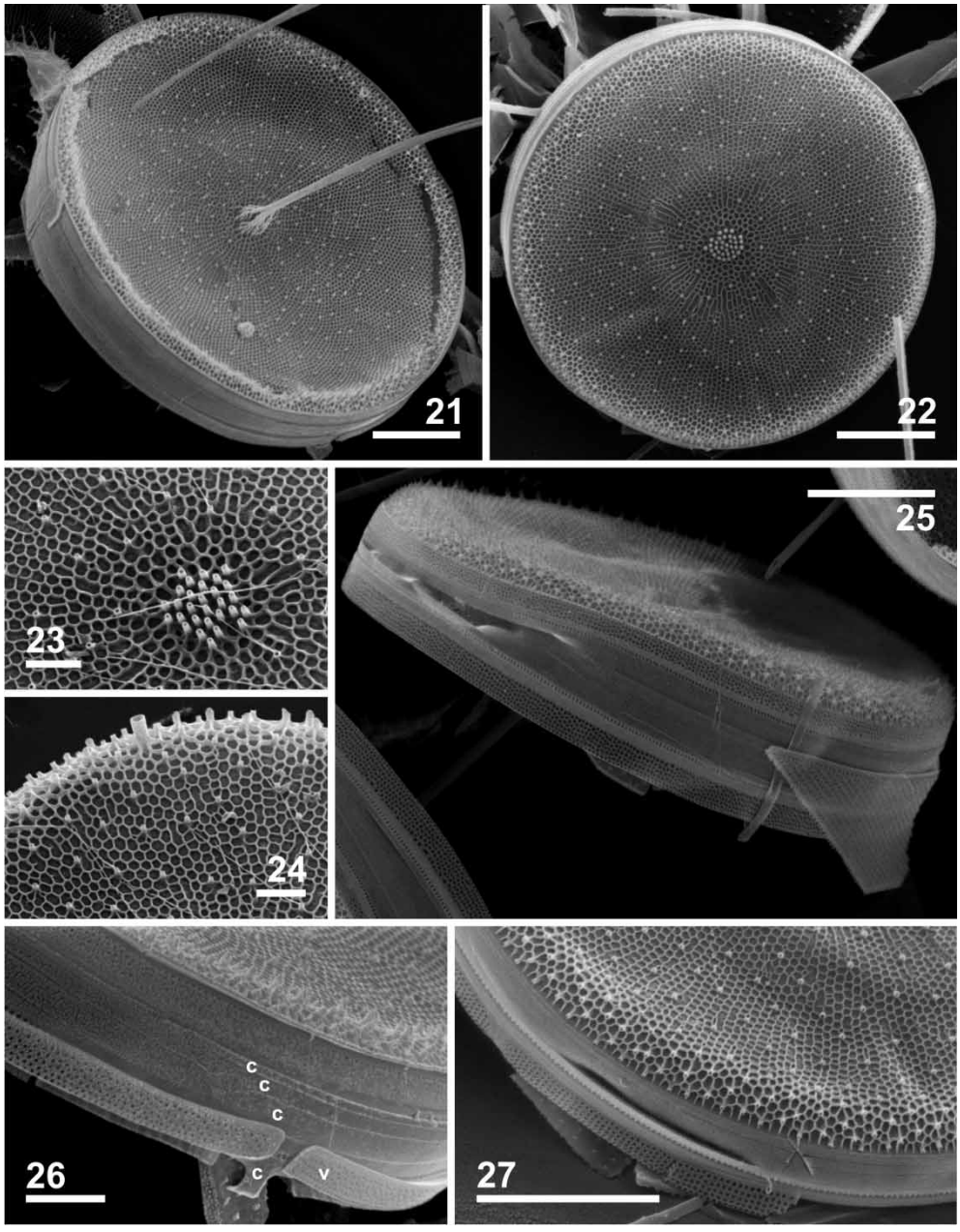
Cells with these morphological patterns were found in late winter from Piedras Coloradas (LPC 13675, 1 September 2006 and LPC 13676, 19 September 2006). The higher abundance including all described morphotypes reached 2.8×10^4 cell L^{-1} in sample LPC 13671.

Discussion

The valve structure consisting of radial ribs in most of the valve surface with some areolae in the central and marginal areas in *T. rotula* and of radial rows of areolae with tendency to the fasciculation in *T. gravida* has been reported as a distinctive feature between these species (e.g., Fryxell 1975b, Hasle & Syvertsen 1997, Throndsen et al. 2007). However, in the same samples from Piedras Coloradas, there are colonies clearly identified as either *T. rotula* and *T. gravida*, while valves similar to *T. gravida* or *T. rotula* alternate in other colonies. Similar observations have been reported from Cape Town, Oslofjord and the Gulf of St. Lawrence (Syvertsen 1977). In the same sense, Bérard-Therriault et al. (1999) stated 'nous retrouvons tous les intérmediares et parfois les deux espéces dans les mêmes échantillons' from the Gulf of St. Lawrence. In addition, the experimental results obtained by Syvertsen (1977) about the valve morphology typical of *T. rotula* at 17 °C and of *T. gravida* at 3 °C should be considered as evidence indicating that the valve structure is not a striking feature in distinguishing both taxa.

According to Hasle (1968), the arrangement of the fultoportulae is a feature that 'seems often to characterize the species in a better way than the valve structure proper, the areolation' and, as pointed out in the literature, the fultoportulae pattern of *T. rotula* and *T. gravida* is the same (Hasle 1968, Sancetta 1990, Harris et al. 1995). In this sense, all the material analyzed in this article shares the same fultoportulae pattern.

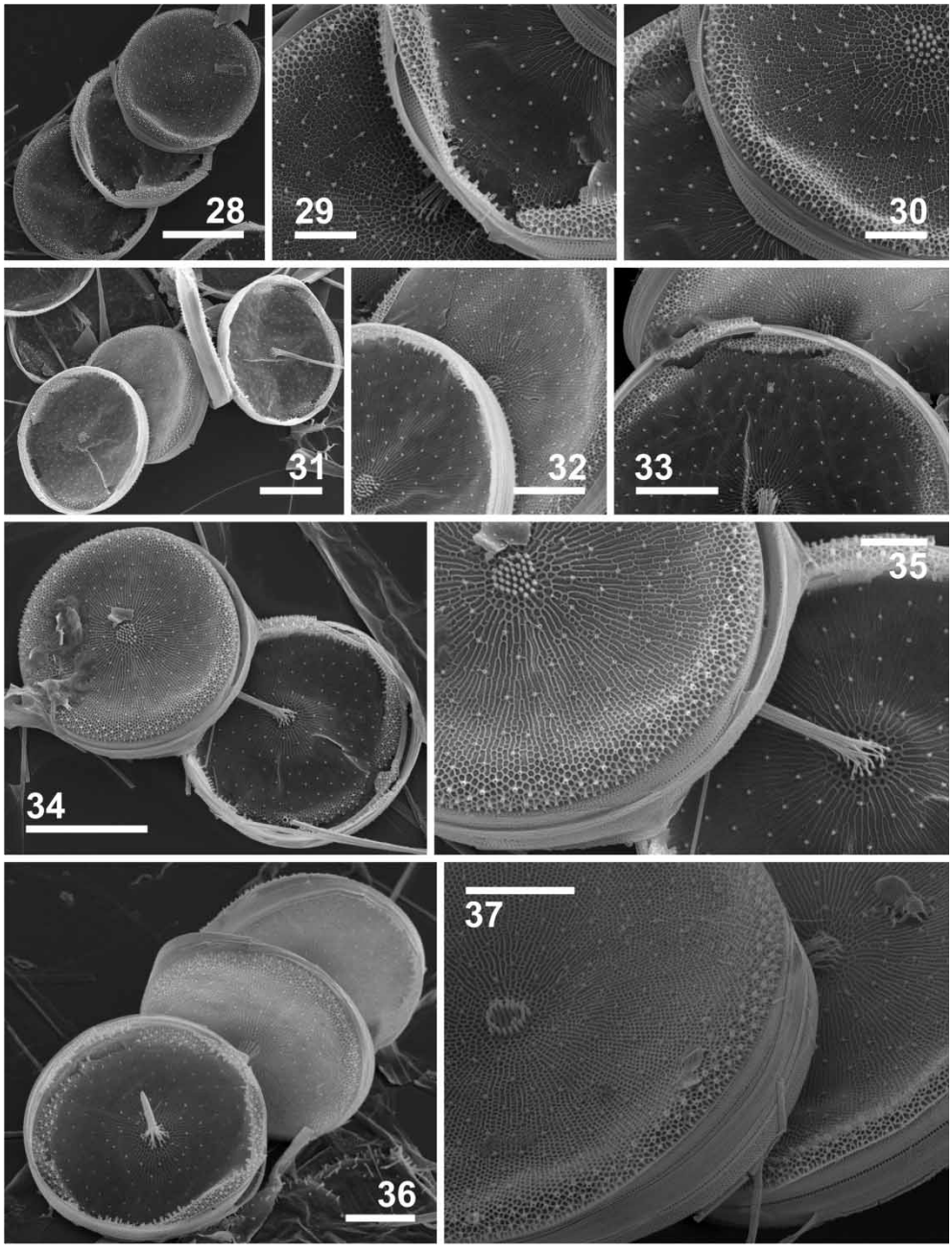
In the protologue of *T. rotula*, Meunier (1910) described the presence of an unevenly thickened band in the cingulum as a striking feature distinguishing this species from *T. gravida*. However, Fryxell (1975b) did not observe the



Figs 21–27. *Thalassiosira gravida*. LPC 13675. SEM. **Fig. 21.** Frustule in tilted view showing fultoportulae and the cingulum. **Fig. 22.** Frustule showing fultoportulae pattern. Note rimoportula. **Fig. 23.** Detail of the central cluster of fultoportulae. **Fig. 24.** Valve margin showing the fultoportula pattern and a single rimoportula. **Fig. 25.** Frustule in tilted view showing the cingulum. Note both first copulae unevenly thickened (c). **Fig. 26.** Detail of the cincture showing the complete epicingulum. Note the open valvocopula (v), the ligulate first copula (c), the open second copula (c), the third copula with ligula and antiligula (c) and the open fourth copula (c); band openings are arranged in dextral spiral. **Fig. 27.** Tilted frustule showing the first copula unevenly thickened (c). Scale bars = 10 μm (Figs 21–22, 25, 27); 2 μm (Figs 23–24, 26).

thickening of the copula in *T. rotula* from her culture material, while Syvertsen (1977) reported thickened copula in cells grown between 10 and 17 °C with no nitrate or phosphate added for all clones, including *T. gravida*. In addition, in field material from the same sample, unevenly thickened first copulae were found in some typical colonies that could be identified as *T. rotula* and as *T. gravida*. Based on observations from cultured material given by Fryxell (1975b), Syvertsen (1977) and our field material observations, this is not an important feature by which to distinguish both taxa.

The length of the pervalvar axis was considered another differential feature. Cells of *T. rotula* were commonly described or illustrated as disk-shaped or shortly cylindrical and *T. gravida* as cylindrical (Cleve 1896, Meunier 1910, Harris et al. 1995). Nevertheless, Syvertsen (1977) pointed out that no such difference was found in cultures and Fryxell



Figs 28–37. Colonial *Thalassiosira* with unequal valves in contiguous cells. LPC 13675. SEM. **Fig. 28.** Colony with two *T. gravida*-like valves and one *T. rotula*-like valve. **Figs 29–30.** Details of the contiguous cells in the same colony. **Fig. 31.** Colony with two *T. rotula*-like valves and two *T. gravida*-like valves. **Figs 32–33.** Detail of contiguous cells in the same colony. **Fig. 34.** Two contiguous cells with a *T. rotula*-like valve and the other intermediate cell between *T. rotula* and *T. gravida*. **Fig. 35.** Detail of Fig. 34. Note the intermediate valve. **Fig. 36.** Colony with two *T. gravida*-like valves and one *T. rotula*-like valve. **Fig. 37.** Detail of two contiguous cells with a *T. gravida*-like valve and an intermediate valve. Scale bars = 20 μm (Figs 28, 31, 34); 10 μm (Figs 32–33, 36–37); 5 μm (Figs 29–30, 35).

(1975b) established that *T. rotula* in culture has the same size range as *T. gravida*. In our material, cells that could be attributed to both species have the pervalvar axis always less than 1/3 of the diameter. The variability of this feature reported from culture and field material did not justify it as a distinguishing feature.

The production of resting spores described by Cleve (1896) in *T. gravida* was not identified in cultured material by Fryxell (1975b) or by Syvertsen (1977). Again, resting spores were not found in our material from Piedras Coloradas. In addition, in field material from the Gulf of St. Lawrence and Iceland, Syvertsen (1977) determined that the resting spores ascribed to *T. gravida* correspond to spore valves of *T. antarctica* Comber. Thus, this feature was erroneously considered as a distinguishing feature between *T. rotula* and *T. gravida*.

Concerning the geographic distribution, Hasle (1976) pointed out that '*Thalassiosira gravida* was found from about 70° to 35° in the Northern Hemisphere and from about 77° to 33° in the Southern Hemisphere, while *T. rotula* had a continuous distribution from about 60°N to 43°S' and explicitly commented that the distribution patterns of both species support the assumption of one species.

Harris et al. (1995) found *T. rotula* and *T. gravida* as common species that coexist during the spring diatom bloom in Loch Creran, Scotland (56°32′N–5°29′S), and Sancetta (1990) found them sometimes coexisting in two fjords in British Columbia from about 48° to 50°N. These studies do not contain comments about specimens with valve structures characteristic of the two species.

Takano (1990) showed specimens from Japan and Southeast Asian coastal waters under the name *T. rotula*, including valves with radial ribs over most of the valve surface (figs D and E) and shortly cylindrical cells (fig. B, detail in fig. C), fitting with the concept of *T. rotula*, but with radial rows of areolae as in *T. gravida*. In a similar way, some specimens from the Gulf of California determined as *T. rotula* by Hernández-Becerril & Tapia Peña (1995, figs 49–50), showed a valve structure corresponding to *T. gravida*.

Thalassiosira rotula and *T. gravida* were suspected to be conspecific by Fryxell (1975b), Hasle (1976), Syvertsen (1977) and Muylaert & Sabbe (1996), and comments about the existence of field specimens with a mixture of the valve structures characterizing these two taxa were mentioned by Syvertsen (1977), Bérard-Therriault et al. (1999) and Muylaert & Sabbe (1996) who considered *T. gravida* to be an ecologically induced form of *T. rotula*.

Despite the gathered evidence about the value of the differential features, Syvertsen (1977) hesitated to reject *T. rotula* as a distinct species, arguing that the clone of *T. gravida* did not have the appropriate diameter to permit experiments comparable with those of *T. rotula*.

Taking into account previous analysis, the differential features used to distinguish *T. rotula* and *T. gravida* were not useful, and both taxa are conspecific by sharing fultoportulae pattern and morphology of the cingulum. This latter feature was discussed by Fryxell et al. (1981) as a striking feature at the specific level in the genus *Thalassiosira*. Thus, the name of the species must be *T. gravida* Cleve by the principle of priority, and *T. rotula* Meunier its heterotypic synonym. The morphology should be considered as temperature dependent, as demonstrated experimentally by Syvertsen (1977). The more silicified valve structure (see Semina 2003) is characteristic of higher latitudes of both hemispheres, which coincides with waters generally considered to be rich in silica, as pointed out by Hasle et al. (1971).

Lectotypification of Thalassiosira gravida *Cleve*

Because it was not clear whether slide no. 64 of the Tempère and Peragallo Collection is the syntype material, Cleve's (1896) fig. 14 becomes the lectotype of *Thalassiosira gravida* and slide no. 64 as the epitype slide according to the International Code of Botanical Nomenclature (McNeill et al. 2006). The valve structure of the epitype specimen (Fig. 5) fits the description given by Cleve (1896) perfectly.

Thalassiosira gravida Cleve in *Svenska Vetenskaps-Akademiens Handlingar* 22 (III) 4, p. 12, pl. 2, figs 14–16.

= *Thalassiosira rotula* Meunier in *Microplankton des Mers de Barents et de Kara. Duc d'Orleans, 'Campagne Arctique de 1907'*, p. 264, pl. 29, figs 67–70. Charles Bulens, Bruxelles.

Lectotype: Cleve's (1896) fig. 14 (see Fig. 4).

Epitype (designated here): slide no. 64 Tempère and Peragallo Collection, deposited in the Herbarium at the División Ficología, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata.

Epitype locality: Baffin Bay.

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