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RECORDS OF *CERATOPERIDINIUM* MARGALEF (DINOPHYCEAE) FROM THE MEDITERRANEAN SEA

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CERATOPERIDINIUM
DINOFLAGELLATE
DINOPHYCEAE
PHYTOPLANKTON
MEDITERRANEAN SEA

ABSTRACT. – Records of dinoflagellates of the rare genus *Ceratoperidinium* Margalef *ex* Loeblich III are reported from the Mediterranean Sea. *C. yeye* Margalef was collected from the Bay of Palma de Mallorca (Balearic Is.) and *C. cf. yeye* from the Alborán Sea. From the Lebanese coastal waters, *C. yeye* was also reported and *C. mediterraneum* Abboud-Abi Saab. Other taxon, *Ceratoperidinium* sp., characterised by a distinct elongate apical process, is reported from the Bay of Palma de Mallorca. These species were collected from neritic and epipelagic waters and usually associated with phytoplankton post-bloom conditions.

CERATOPERIDINIUM
DINOFLAGELLÉ
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MER MÉDITERRANÉE

RÉSUMÉ. – Des données sur un genre rare de Dinoflagellé *Ceratoperidinium* Margalef *ex* Loeblich III de Méditerranée sont exposées. *C. yeye* Margalef a été trouvé dans la Mer d'Alborán et la Baie de Palma de Mallorca (Iles Baléares). Dans les eaux côtières libanaises, *C. yeye* et *C. mediterraneum* Abboud-Abi Saab ont aussi été recoltés. *Ceratoperidinium* sp., caractérisé par un prolongement apical distinct, a été signalé dans la Baie de Palma de Majorque. Ces espèces ont été collectées dans des eaux néritiques, épipelagiques et souvent associées aux conditions d'un post-bloom de phytoplancton.

Dinoflagellates are well represented in the oligotrophic waters of the Mediterranean Sea. Despite the relative high number of studies performed in the Mediterranean Sea, some taxa are rarely reported and information on their ecology and distribution is scarce. This is the case for the species of the genus *Ceratoperidinium*.

The systematic position of this genus, which shape is reminiscent of peridiniales and brachydiniaceans, remains uncertain. *Ceratoperidinium* has been considered as a thecate dinoflagellate of the order Peridiniales (Loeblich III 1982, Sournia 1986), but thecal plates have not been observed. According to Fensome *et al.* (1993), the rigid wall may be evidence of a pellicle. These authors placed this genus in the Ptychodiscales as an athecate dinoflagellate.

Ceratoperidinium yeye Margalef *ex* Loeblich III

The type species of the genus *Ceratoperidinium* was described from one individual in the Spanish Mediterranean coastal waters (Margalef 1969). The

species presented a total length of 184 μm (63 μm excluding the antapical appendices) and a transversal diameter of 50 μm (Fig. 1A). This taxon was re-described as *Ceratoperidinium margalefii* by Loeblich III (1980) due to the lack of Latin diagnosis.

Later, Abboud-Abi Saab (1989) reported one specimen of *C. yeye* found in November 1988 at 5 m depth in the Lebanese coastal waters (33° 57' 34''N, 35° 35' 47''E). The Lugol fixed specimen was collected from waters with a temperature of 22°C, salinity 39.53, nitrate 0.26 μM and phosphate 0.04 μM . Mainly diatoms composed the surrounding phytoplankton assemblage, reaching an abundance of 6.1 cells ml^{-1} and dinoflagellates (mainly athecate forms) reaching an abundance of 3 cells ml^{-1} . The total length of the specimen was 236 μm , 67 μm excluding the appendices and the transdiameter was 59 μm . The cell size excluding the antapical appendices represented 25% of the total length. This specimen presented differences with the type species such as bigger size and protuberances that started at the 1/3 from the proximal

part, distributed regularly towards the tips of the antapical appendices (Fig. 1B).

Velásquez (1997) reported two records of *C. yeye* in the Gulf of Lions (NW Mediterranean Sea) in February 1988.

During a survey carried out in September 1999, one specimen that resembles *C. yeye* was observed at 20 m depth in the NW Alborán Sea (36°05'N, 05°12'W) from Lugol fixed water samples (Fig. 1D). Temperature was 17.3°C, salinity 36.77, nitrate 0.15 µM and phosphate 0.03 µM. The microphytoplankton assemblage was dominated by diatoms that reached an abundance of 7.7 cells ml⁻¹, mainly *Dactyliosolen fragilissimus*, *Leptocylindrus*

danicus, *L. minimus* and *Pseudo-nitzschia* spp, whereas dinoflagellates reached an abundance of 2.6 cells ml⁻¹ dominated by *Gymnodinium catenatum*. The observed phytoplankton assemblage corresponded to post-bloom conditions, in contrast with an assemblage dominated by *Chaetoceros curvisetus* more typical under the eutrophic conditions in this area (Gómez *et al.* 2000).

No size measurements of this specimen were performed. Cell size excluding the antapical appendices represented 29% of the total size whereas in the Margalef's figure this ratio was 34%. The antapical appendices were thicker than those

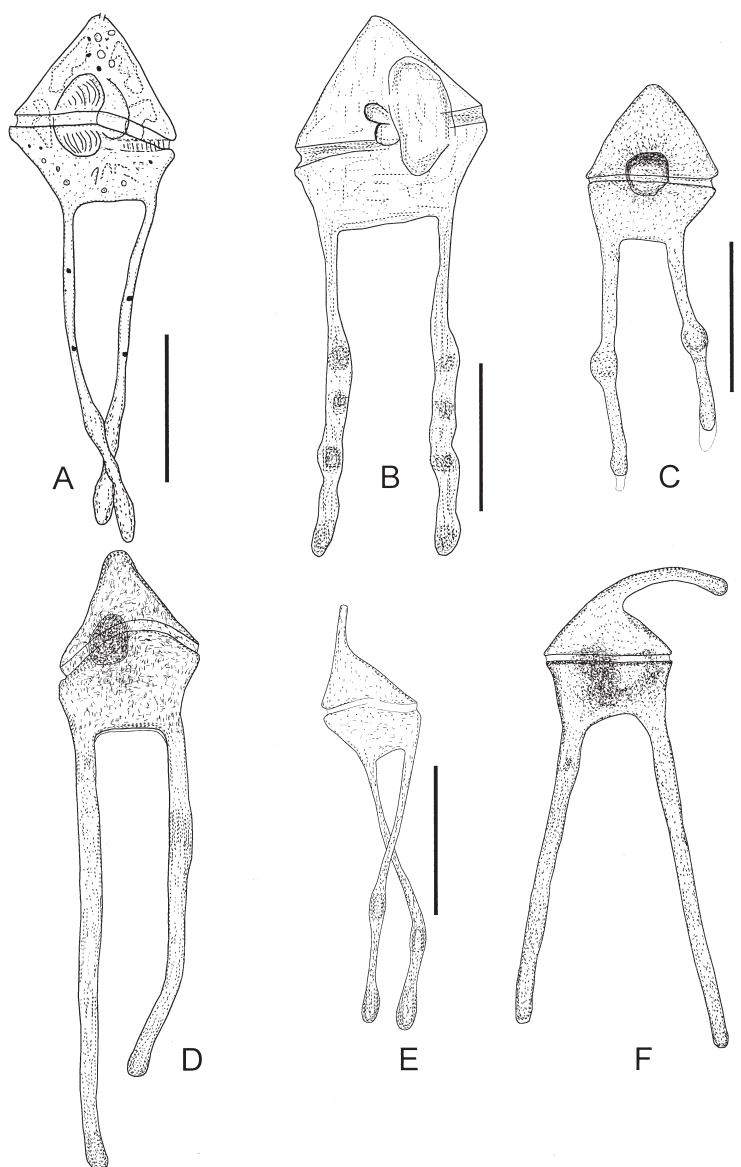


Fig. 1. – Line drawings of the records of *Ceratoperidinium* spp in the Mediterranean Sea. A, The type species, *Ceratoperidinium yeye* Margalef, adapted from Margalef (1969). B, *C. yeye* from the Lebanese coastal waters. C, *C. yeye* collected from the Bay of Palma de Mallorca (Balearic Is.). D, *Ceratoperidinium* cf. *yeye* recorded from the NW Alborán Sea. E, *Ceratoperidinium mediterraneum* Abboud-Abi Saab from the Lebanese coastal waters. F, *Ceratoperidinium* sp. collected from the Bay of Palma de Mallorca. Scale bar: 50 µm.

shown in Margalef (1969) and protuberances were not observed along the appendices.

In October 2001, a specimen of *C. yeye* was observed at 10 m depth in the Bay of Palma de Mallorca (Balearic Is.) (39°32'N, 2°36.3'E) from Lugol fixed water samples. The cell was 131 µm long (51 µm excluding the appendices) and the transdiameter was 42 µm (Fig. 1C). The antapical appendices were also thicker than those in Margalef's drawing and both of them presented clear protuberances in the middle of the appendices.

Ceratoperidinium mediterraneum Abboud-Abi Saab

Abboud-Abi Saab (1989) described this species from the Lebanese coastal waters from one specimen. The main characteristic of this taxon in comparison to *C. yeye* is the presence of a tip-rounded tubular apical (capitate) process (Fig. 1E). The total length was 134 µm, 46 µm excluding the appendices and the cingulum was 42 µm width (cell size excluding the antapical appendices represented 34% of the total size). The type species was found in July 1982 at 5 m depth in a coastal station (34°00'50''N, 35°30'40''E). The temperature was 27.2°C, salinity 39.2, nitrate 0.11 µM and phosphate 0.03 µM. The phytoplankton assemblage corresponded to spring post-bloom conditions dominated by diatoms (mainly *Dactyliosolen fragilissimus*) reaching an abundance of 23.6 cells ml⁻¹ whereas the abundance of dinoflagellates was low (0.32 cells ml⁻¹). In October 1988, at the same station and the same depth, another specimen was collected with a total length of 137 µm (55 µm excluding the appendices) and the cingulum was 47 µm width. Cell size excluding the antapical appendices represented 40% of the total size. This specimen was collected from waters with a temperature of 26.6°C and a salinity of 39.3.

Ceratoperidinium sp

In November 2001, one specimen of the genus *Ceratoperidinium* was collected in the Bay of Palma de Mallorca (Balearic Is.) at 10 m depth. The cingulum diameter was 39 µm width and 112 µm of total length (including antapical and apical appendices) (Fig. 1F). This taxon presented a distinctive curved apical process more elongate than that of *C. mediterraneum*. In *Ceratoperidinium* sp. the antapical appendices were thicker than those in *C. yeye* and *C. mediterraneum* and protuberances along the antapical appendices were not observed. These characteristics resemble the antiapical appendices of the specimen *C. cf. yeye*, collected from the Alborán Sea. Based on the

Table I. – Records of *Ceratoperidinium* spp, including historical records.

Location (depth)	#	Date	Reference
<i>C. yeye</i>			
Castellón coast (10 m)	1	Aug., 1967	Margalef, 1969
Lebanese coast (5 m)	1	Nov., 1988	Abboud-Abi Saab, 1989
Gulf of Lions	2	Feb., 1988	Velásquez, 1997
Mallorca Bay (10 m)	1	Oct., 2001	This study
<i>C. cf. yeye</i>			
NW Alborán Sea (20 m)	1	Sept., 1999	This study
<i>C. mediterraneum</i>			
Lebanese coast (5 m)	2	Jul., 1982, Oct., 1988	Abboud-Abi Saab, 1989
<i>Ceratoperidinium</i> sp			
Mallorca Bay (10 m)	1	Nov., 2001	This study

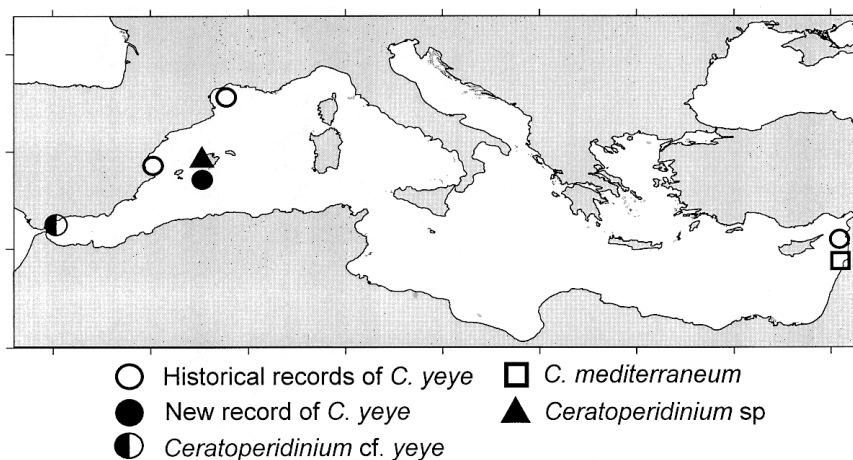


Fig. 2. – Location of the records of *Ceratoperidinium* spp.

length of the apical process, *C. mediterraneum* appears as an intergraded taxon between *C. yeye* and *Ceratoperidinium* sp.

Final remarks

As general trend, *C. yeye*, *C. mediterraneum* and *Ceratoperidinium* sp. seem to appear in coastal waters, being preferentially recorded from surface waters and usually associated with phytoplankton post-bloom conditions. Most of the specimens were collected under thermophilic conditions (summer-autumn), however the records by Velásquez (1997) in the Gulf of Lions in winter prevent us to considering *Ceratoperidinium* as a strictly warm-waters genus.

According to the available knowledge on the geographical distribution of *Ceratoperidinium*, these species can be considered as an exclusively Mediterranean taxa (Table I, Fig. 2). Despite the distinctive morphology, relative large size and being preferentially found in the surface coastal waters (more intensely studied), the records of these taxa are extremely low.

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