

First records of the dinoflagellate genus *Dicroerisma* (Actiniscales, Dinophyceae) in the Mediterranean Sea

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*This study is the first to describe and illustrate the dinoflagellate genus *Dicroerisma* in the Mediterranean Sea. Twenty individuals ascribed to *Dicroerisma psilonereiella* were encountered. The highest abundance (12 cells L⁻¹) was recorded in the Balearic Sea at 50 m depth. Other specimens were found in subsurface waters (>75 m depth, with some records at 250 m depth) in the Ionian and Levantine Basin. These findings suggest that *Dicroerisma* is a widespread genus and its presence has gone unnoticed due to its small size, deep water distribution and misidentification with other gymnodinioid cells*

Key words: biodiversity, *Dicroerisma*, *Dinophyta*, introduced species, Mediterranean Sea, non-indigenous taxa, invasive phytoplankton

INTRODUCTION

About 700 species of dinoflagellates have been reported in the Mediterranean Sea, including ca. 90% of the dinoflagellate genera of the world's oceans (GÓMEZ, 2003, 2005). Despite the historical tradition of taxonomic studies, some genera remain unreported in the Mediterranean basin. TAYLOR & CATTELL (1969) described the genus *Dicroerisma* from Canadian Pacific coastal waters. The type, *D. psilonereiella* F.J.R. Taylor & S.A. Cattell, was described as a non-photosynthetic gymnodinioid cell possessing a single, hollow, internal skeletal element, longitudinally orientated and forked in the manner of an inverted Y. *Dicroerisma psilonereiella* was later reported from other cold regions of the northern hemisphere (HARVEY *et al.*, 1997; BÉRARD-TERRIAULT *et al.*, 1999; HORNER *et al.*, 2005; SIMAKOVA & KONOVALOVA, 1995; SERGEE-

VA *et al.*, 2010). TAYLOR (1976) reported one individual from the warm Indian Ocean. Recent records from the northern, equatorial and southern Pacific Ocean revealed that the geographical distribution of *Dicroerisma* was wider than previously known (GÓMEZ, 2008a). One specimen that corresponded to a second species was described from the tropical western Pacific Ocean (GÓMEZ, 2008a). *Dicroerisma* has been recorded in all the world oceans, but has been previously unreported in the Mediterranean Sea (GÓMEZ, 2003). The present study describes and illustrates the first records of *Dicroerisma* in the Mediterranean Sea.

MATERIAL AND METHODS

Samples were collected during the BOUM (Biogeochemistry from the Oligotrophic to the Ultra-oligotrophic Mediterranean) cruise on

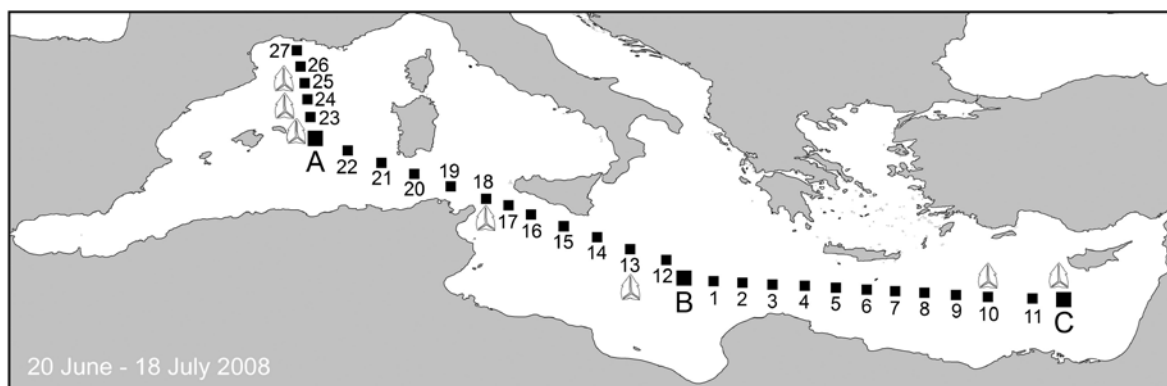


Fig. 1. Map of the station locations in the Mediterranean Sea during the BOUM cruise in June-July 2008

board R/V *L'Atalante* from the south of France to the south of Cyprus (20 June-18 July 2008) (Fig. 1).

Seawater samples were collected by Niskin bottles from 30 stations. At each station 6 depths were sampled between 5 and 125 m and an additional sample at 250 m depth. These were preserved with acid Lugol's solution and stored at 5°C. Samples of 500 mL were concentrated via sedimentation in glass cylinders. The top 450 mL of sample was slowly siphoned off with small-bore tubing during 6 days. The remaining 50 mL of concentrate, representing 500 mL whole water, was then settled in composite settling chambers. The sample was examined

at 100 × magnification with a Nikon inverted microscope (Nikon Eclipse TE200) and the specimens were photographed with a digital camera (Nikon Coolpix E995).

RESULTS AND DISCUSSION

A total of 20 specimens of *Dicroerisma psiloneriella* were recorded from 212 samples (Table 1). These pear-shape gymnodinioid cells were slightly dorso-ventrally compressed. The episome was conical and sharply pointed. The hyposome was slightly bilobed with two small antapical tips, more developed in some specimens. The cingulum was deeply impressed.

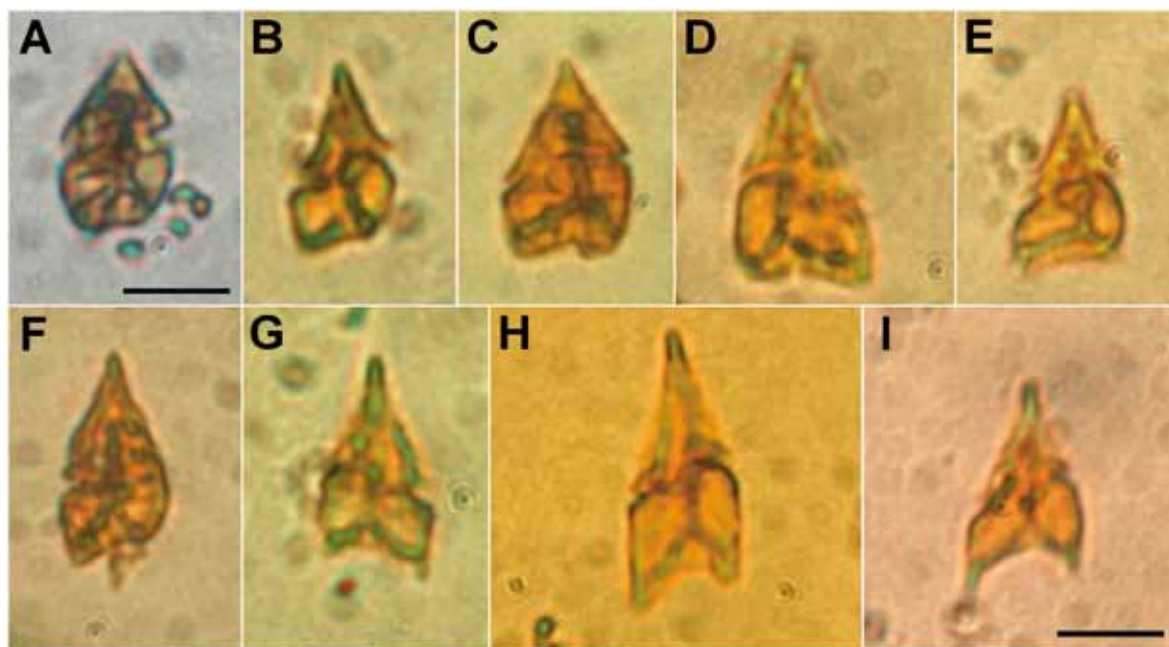


Fig. 2A-I. Photomicrographs of Lugol-fixed specimens of *Dicroerisma psiloneriella*, under bright field optics. See Table 1 for the location of the records. Scale bar = 20 μm

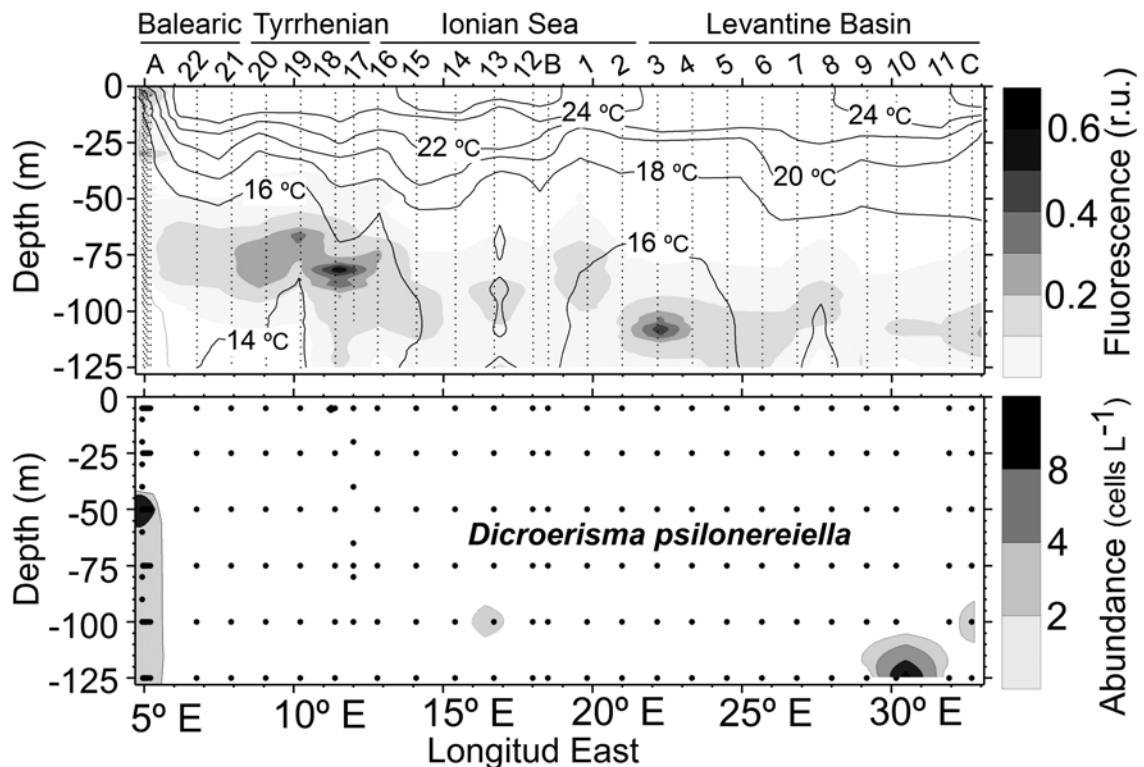


Fig. 3. Section plots of the temperature (°C) and fluorescence (relative units) in the upper panel, and the abundance of *Dicroerisma psilonereiiella* (cells L⁻¹) in the lower panel

The most distinctive morphological feature was the Y-shaped endoskeleton that extended longitudinally from near the apex and bifurcated at the base of the hyposome. From Lugol-fixed specimens, the maximum length ranged from 24 to 34 μm and the width was 15-20 μm at the cingulum level (Fig. 2). The highest abundance (12 cells L⁻¹) was found at 50 m depth in the Balearic Sea (station 27). All the other specimens were encountered below 75 m depth, with two records from samples collected at 250 m depth (Fig. 3, Table 1).

Dicroerisma has been considered as an introduced phytoplankton species in the northern European seas (GOLLASCH *et al.*, 2008). However, *Dicroerisma* should be considered as a previously unnoticed or misidentified species in the past as is the case with numerous other phytoplankton species (GÓMEZ, 2008b). The small size and the misidentification with other gymnodinioid species are responsible for the paucity of records. In the present day, we can expect the spreading of warm-water species

associated with warming in the Mediterranean Sea. *Dicroerisma* was first described from boreal waters and is commonly reported in polar waters (SERGEEVA *et al.*, 2010). The recent record of *Dicroerisma* in the Mediterranean Sea is not an example of the expansion of thermophilic phytoplankton species. This study will facilitate the recognition of *Dicroerisma* and possibly additional records.

ACKNOWLEDGEMENTS

I am supported by the contract JCI-2010-08492 of the Ministerio Español de Ciencia y Tecnología. I thank K. LEBLANC and V. BARTHAUX for the BOUM samples. This is a contribution of the BOUM (Biogeochemistry from the Oligotrophic to the Ultraoligotrophic Mediterranean) project of the French national LEFE-CYBER program and of the European IP SESAME

Table 1. Records of *Dicroerisma psilonereiella* in the Mediterranean Sea. Sampling stations, date, depth (meters) and geographic coordinates (latitude, longitude)

Number of specimens	Station number	Date	Depth (m)	Coordinates	Figure
#6	St. 25	18 Jul 2008	50	41° 59.9'N, 4° 59.5' E	Fig. 2A
#1	St. 25	18 Jul 2008	125	41° 59.9'N, 4° 59.5' E	Fig. 2B
#1	St. 24	18 Jul 2008	75	41° 5.26'N, 5° 3.25' E	Fig. 2C
#1	St. 24	18 Jul 2008	125	41° 5.26'N, 5° 3.25' E	-
#2	St. 23	17 Jul 2008	75	40° 10.7'N, 5° 6.7' E	Fig. 2D, E
#1	St. 23	17 Jul 2008	100	40° 10.7'N, 5° 6.7' E	Fig. 2F
#1	St. 13	08 Jul 2008	100	34°52'N, 16°42' E	-
#1	St. 18	09 Jul 2008	250	37° 49.9'N, 11° 23' E	Fig. 2G
#1	St. C	29 Jun 2008	250	33° 37.5'N, 32° 39.2' E	Fig. 2H
#1	St. C	26 Jun 2008	100	33° 31.5'N, 32° 42.9' E	-
#4	St. 10	24 Jun 2008	125	33° 41.9'N, 30° 9.6' E	Fig. 2I

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Received: 8 November 2010

Accepted: 26 April 2011

Prvi nalazi dinoflagelata roda *Dicroerisma* (Actiniscales, Dinophyceae) na Sredozemnom moru

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Ova studija je prva koja opisuje i ilustrira dinoflagelata svojte *Dicroerisma* u Sredozemnom moru.

Pronađeno je dvadeset jedinki koje pripadaju vrsti *Dicroerisma psilonereiella*. Najveća abundancija (12 stanica L-1) zabilježena je u Balearskom moru na 50 m dubine. Ostali primjerci pronađeni su neposredno ispod površinskog sloja (> 75 m dubine, s nekim zapisima na 250 m dubine) u Jonskom i istočnom Sredozemnom moru. Ovi rezultati ukazuju da je *Dicroerisma* raširena svojta, a njena prisutnost je prošla nezapaženo upravo zbog male veličine jedinki, raspodjele u dubokom moru i pogrešne identifikacije u odnosu na druge gymnodinioidne stanice.

Ključne riječi: biološka raznolikost, *Dicroerisma*, Dinophyta, unesena vrsta, Sredozemno more, alohtone svojte, invazivni fitoplankton

