RESTING STAGES PRODUCED BY PLANKTON IN THE BLACK SEA – BIODIVERSITY AND ECOLOGICAL PERSPECTIVE

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Abstract

To study the potential "hidden" biodiversity of the plankton in the Western Black Sea and species that could represent an ecological concern in the future, resting cysts were analyzed for the first time in superficial sediments along a transect offshore the city of Varna (Bulgaria) and a sediment trap material from the open sea. An interesting finding was the record of eight species (in resting phase), new in the Black Sea. Based on the bioinvasion history and the ecological affinity of the observed species (cysts), the results suggest future implications for the Black Sea ecosystem and biodiversity.

Keywords: Plankton, Biodiversity, Blooms, Sediments, Black Sea

Introduction

Resting stage (cyst) production is a common life-cycle trait in many species of the marine plankton of multiple function: a strategy to overcome unfavourable conditions, a "seed population" for bloom initiation and re-colonization of the pelagic domain, aiding in the genetic recombination of the population and more effective mobilization of nutrients. Both, the abundance of resting stages in the sediments and the number of cyst-producing species suggest this trait as a driving force of plankton dynamics and biodiversity [1]. As in the framework of the EU SESAME Project, one of the general objectives was to assess and predict changes in the Black Sea ecosystem, the study of cyst bank produced by plankton was deemed an efficient approach, since these assemblages play the role of a "memory" and "early warning" of the plankton structural dynamics, storing the information about past and future communities. As the first targeted research of this scale in the Black Sea, the primary goal was to study plankton biodiversity hidden in the sea floor as modern cyst assemblages.

Study area and Methods

Surface sediments were sampled between April 2008 and April 2009 at 12 stations in the Western Black Sea (Galata transect) during 3 cruise campaigns. In addition material collected by a sediment trap deployed at 900 m in the deep sea was analyzed too. Sub-samples were processed by means of a sieving technique [2] to concentrate cysts for their identification under light microscope and for germination experiments.

Tab. 1. List of the 64 resting stage *taxa* from Western Black Sea sediments.
♦new records for the study area
§cyst morphotypes found only in the sediment trap

	Dinophyta		*Scrippsiella trochoidea* (Stein) Loeblich III
♦	*Alexandrium minutum* (Halim) Balech		*Scrippsiella* sp.1
♦	*Alexandrium tamarense* (Lebour) Balech		*Scrippsiella* sp.2
	Alexandrium sp.		*Scrippsiella* sp.3
	Bicarinellum tricarinelloides Versteegh		*Scrippsiella* sp.4
§	*Calcicarpinum perfectum* Versteegh	§	*Scrippsiella* sp.5
♦	*Calciodinellum operosum* Deflandre		Dinophyta sp.1
	Calciodinellum sp.		Dinophyta sp.2
	Calciperidinium asymmetricum Versteegh		Dinophyta sp.3
♦	*Cochlodinium polykrikoides* Margalef		Dinophyta sp.4
	Diplopsalis lenticula Bergh		Dinophyta sp.5
	Diplopsalis sp.		Dinophyta sp.6
	Gonyaulax group		Dinophyta sp.7
♦	*Gymnodinium impudicum* (Fraga & Bravo) Hansen & Moestrup		Dinophyta sp.8
♦	*Gymnodinium nolleri* Ellegaard & Moestrup		Dinophyta sp.9
	Gymnodinium sp.		Dinophyta sp.10
§	Gymnodiniales sp.		Dinophyta sp.11
	Lingulodinium polyedrum (Stein) Dodge		Dinophyta sp.12
	Melodomuncula berlinensis Versteegh		Dinophyta sp.13
	Oblea rotunda (Lebour) Balech ex Sournia		
	Pentapharsodinium dalei Indelicato & Loeblich		**Ciliophora**
	Pentapharsodinium tyrrhenicum (Balech) Montresor, Zingone & Marino	§	*Cyrtostrombidium boreale* Kim, Suzuki & Taniquchi
	Pheopolykrikos hartmannii (Zimmerman) Matsuoka & Fukuyo		*Strombidium acutum* Leegaard
	Polykrikos kofoidii Chatton		*Strombidium conicum* Kim & Taniguchi
§	*Protoceratium reticulatum* (Claparède & Lachmann) Bütschli		Ciliophora sp.1
	Protoperidinium compressum (Abé) Balech		Ciliophora sp.2
	Protoperidinium conicum (Gran) Balech	§	Ciliophora sp.3
	Protoperidinium oblongum (Aurivillius) Parke & Dodge		Ciliophora sp.4
	Protoperidinium thorianum (Paulsen) Balech		
	Protoperidinium sp.1		**Rotifera**
§	*Protoperidinium* sp.2	§	*Synchaeta* sp.
§	*Protoperidinium* sp.3		
♦	*Scrippsiella lachrymosa* Lewis		**Copepoda**
♦	*Scrippsiella ramonii* Montresor	§	*Acartia* sp.1
♦§	*Scrippsiella spinifera* Honsell & Cabrini	§	*Acartia* sp.2
♦	*Scrippsiella trifida* (Stein) Loeblich III		

Results and Discussion

In the surface sediment samples a total of 59 cyst morphotypes were determined, mostly produced by dinoflagellates, out of which 5 were identified as ciliate resting stages based on their peculiar flask-like shape. In the sediment trap sample, 45 different morphotypes were found, mostly dinocysts, together with two ciliates flasks, one rotifer and two *Acartia* resting eggs (copepod). In the sediment trap material 12 different cyst morphotypes not present in the surface sediments were discovered. Thus the total number of cyst morphotypes observed in this study was 71, out of which 61 produced by dinoflagellates, 7 by ciliates, 1 by rotifers and two by copepods, corresponding to 64 *taxa* (Table 1).

Even if cyst-forming species constitute a small part of the plankton dinoflagellates recorded in the area, eight species, have never been observed in the Black Sea (Table 1). Three of them were detected also for the first time in the plankton samples collected during the SESAME cruises. *Alexandrium tamarense* (cyst) and *Cochlodinium polykrikoides* (motile cells) have been reported in surface sediments and water column respectively from Odessa Bay (Northern Black Sea) [3], but for the Bulgarian area this represents the first record.

The most abundant cyst morphotypes at all stations were those produced by *Scrippsiella trochoidea* (Stein) Loeblich III, a species responsible for frequent blooms in the area. As evident from the species (cyst) list a high variety of *Scrippsiella* species (cysts) was recognized among which 4 new for the Black Sea phytoplankton. The proportion of cysts density shed light on the co-existence of *Pentapharsodinium dalei* - *P. tyrrhenicum* - *S. trochoidea*, confirming the dominance of *S. trochoidea* in the phytoplankton assembly. The results suggest that the originally reported *S. trochoidea*, in fact, represents a variety of species, *e.g.* should be treated as *Scrippsiella complex*. Some interesting findings were related to the paleontological *taxa Bicarinellum tricarinelloides*, *Calcicarpinum perfectum*, *Calciperidinium asymmetricum* and *Melodomuncula berlinensis*, whose active stages are not known. But, their increasing records from the surface sediments and trap samples, together with some successful germination experiments, testify the modern status of the species, as the case of *Calciodinellum operosum*, originally described as fossil by Deflandre. These new records confirm the need to carry out an integrated study of water column and sediments which could complete the list of species [4] and add value to potential implications for the pelagic ecosystem. The recent history of bioinvasions in this particular environment, calls for further investigations of biodiversity as an imperative for the sustainable management of the Black Sea ecosystem.

References

1 - Boero F., Belmonte G., Fanelli G., Piraino S. and Rubino F., 1996. The continuity of living matter and the discontinuities of its constituents: do plankton and benthos really exist? *Trends Ecol. Evol.*, 11: 177-180.

2 - Rubino F., Belmonte M., Caroppo C. and Giacobbe M., 2009. Dinoflagellate resting stages from surface sediments of Syracuse Bay (Western Ionian Sea, Mediterranean). *Deep Sea Res. II*, doi:10.1016/j.dsr2.2009.09.011.

3 - Terenko L., 2005. New dinoflagellate (Dinoflagellata) species from the Odessa Bay of the Black Sea. *Oceanol. Hydrol. Studies*, 34: 205-216.

4 - Rubino F., Saracino O.D., Moscatello S. and Belmonte G., 2009. An integrated water/sediment approach to study plankton (a case study in the southern Adriatic Sea). *J. Mar. Syst.*, 78: 536-546.