Cysts of blooming dinoflagellates from Black Sea

Snejana MONCHEVA

Department of Marine Biology and Ecology
Institute of Oceanology - BAS - VARNA (Bulgaria)

The fact that blooms in Black Sea are spreading both in space and time is related to recurently increased anthropogenic impact on the basin (BODEANU 1984, ZAITZEV 1986, NESTEROVA 1987). While there is much information on species involved and environmental factors contributing to these events almost no attention has been paid to dinoflagellates life cycle and its relation to the blooms in Black sea ecosystem. The present paper is aimed at investigation the different stages in life history of the most frequent blooming dinoflagellates along the Bulgarian Black Sea coast.

Both phytoplankton sampling and laboratory culture experiments have been undertaken. Phytoplankton was monitored on monthly and weekly rates in Varna Bay (Bulgarian Black Sea coast) for species composition, abundance outbursts and blooming species populations morphological heterogenity during the period 1984-1991. The details on monoculture procedures and phytoplankton succession are given elswhere Moncheva 1991 a,b). All species counts are made following the inverted microscope technique.

For most of the dinoflagellates blooming along the Bulgarian Black Sea coast, sexual reproduction has already been reported in the literature (Tabl.1)

Heterocapsa triquetra: Vegetative cells are present in the plankton during winter, spring and autumn and entirely absent in summer months with almost regular blooms in April - May. Oval, thick walled structures with d=28-31μ have been registered in May 1988 at a population density of 3.1x10^5 cells/l amounting to 1.9x10^5 cells/l (e.g.64%) at the surface and varying with depth (down to 15 m) from 36 to 72% (fig. 1a). At t° above 20°C no vegetative cells are present in the plankton. Perhaps encystment may be related to t° factor which is quite in agreement with Susumu (1986).

Table 1: Dinoflagellate species blooms along the bulgarian sea coast (1984-1991)

year / species	1984 a	1984 b	1985 a	1985 b	1986 a	1986 b	1987 a	1987 b	1988 a	1988 b	1989 a	1989 b	1990 a	1990 b	1991 a	1991 b	Sexual * cycle known
Prorocentrum minimum	7 11	8.6 60.1	6 7	0.7 0.4	6	480	7	30.5	7	3.2	6	250	6	1.6	7	41.5	ND
Heterocapsa triquetra	5	39.5	4	3.8	5	13.6			5	47.3	6	5					+
Prorocentrum micans	11	2.9					10	1					7	1.2	7	1.2	ND
Goniaulax polyedra	11	1.4					10	2.2	7	1.3							+
Scrippsiella trochoidea											7	16	7	0.2	8	1.9	+
Polykrikos schwartzii											6	0.08			7 8.9	0.02 0.05	+
Gymnodinium catenatum															7 8.9	0.9 2.7	+

a - month; b - abundance (1x10^6 cells/l); ND - no data; * - after MATSUOKA *et al.* (1989)

Prorocentrum minimum: vegetative cells present in the plankton throughout the whole year with local and regional blooms (1979, 1986) both in late spring - summer and autumn months. In June 1988 at t° above 20°C and cell density 9.2x10^5 - 1.5x10^5 (19.4%.) cells/l are dark brown spheres of d=12μ without flagella (fig.1b), the same structures being registered in old lab cultures.

Prorocentrum micans: As vegetative cells also found throughout the year with irregular outbursts (tabl. 1). Naked dark brown spheres of d=30μ found for the first time in 1984 are identical to the structures reported by BRAARUD, ROSSAWICK (1951) as cysts (fig. 1c.). In 1987 at t° 18°C and 1.1x10^6 cells/l they amount to 9.4x10^3 cells/l. In the same sample in von Stosch medium at 22°C in lab the number of vegetative cells increase to 4.5x10^6 cells/l and that of the spheres to 169x10^3 cells/l. In old culture (11.3x10^6 cells/l) they amount to 270.5x10^3 cells/l.

Goniaulax polyedra: Vegetative cells present mainly in spring-summer and autumn months. Cysts are registered for the first time in Nov. 1984. In Oct. 1987 at t° 18°C and concentration of cells 2.2x10^6 the cysts number is 67.6x10^3. In lab at 22°C after 2 days incubation in von Stosch medium the ratio is inverse - 788.9x10^3 vegetative cells and 1.2x10^6 cells/l cysts.

Scrippsiella trochoidea: For the first time the species is found in the plankton in 1989. Cysts (oval cells, d=25-30μ, with very short and tiny spines) identified at t° above 20°C at cell density 1.9x10^6 cells/l in conc. 11.6x10^3 (16.8%) in August 1991. Absent in the plankton in winter - late autumn months.

Polykrikos schwartzii: Absent in the plankton in winter - late autumn months. Cysts identified in July 1989 at the water - bottom interface at a density of 4x10^5 cells/l while the number of vegetative cells in the plankton is 2.5x10^5 cells/l.

Gymnodinium catenatum: A new species in Black sea phytoplankton found for the first time in 1991. No cysts detected yet.

For the species *P. micans* and *P. minimum* whether the cysts are planozygotes or temporary cysts needs further investigation. The role suggested for the cysts includes short and longterm survival in adversory conditions, bloom initiation, species dispersion, genetic restoration but the importance of these roles remains largely hypothetical (PFIESTER and ANDERSON, 1987, BINDER and ANDERSON, 1990). As most of the species reported are present throughout the whole year as vegetative cells, it is rather speculative to consider cysts only a way of survival under unfavourable conditions. As we consider eutrophication an ecological background of high density population maintenance, we are likely to consider sexual reproduction induced by eutrophication, responsible for nuclear reorganization and population genetic restoration (MADHU, 1980).

The documentation of cysts reported makes it possible to revise the concept about phytoplankton assemblages formation along the Bulgarian Black Sea coast (PETROVA - KARADJOVA, 1973) and proves its relative autonomy of development addressing especially the local blooms.

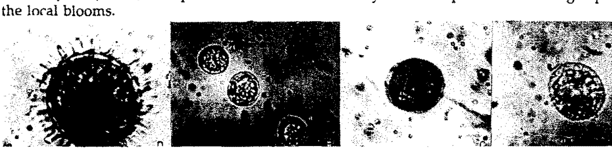

Fig.1: Cysts of *Heterocapsa triquetra* - a; *Prorocentrum minimum* - b; *Prorocentrum micans* c; *Goniaulax polyedra* - d(x750).

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