Solar control upon the phytoplankton in the Black Sea

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Multiannual dynamics of phytoplankton along the Bulgarian Black Sea coast (cells number $10^6/m^3$, biomass mg/m^3) was investigated by us in the period 1954-1990.

During the period 1954-1960 we established a gradual decrease of the phytoplankton biomass of the water area from the estuary of the Danube to the Bosphorus (PETROVA, 1960). The structure of the phytoplankton in the water space has a seasonal characteristic and it is strongly influenced by the temperature, salinity and nutrients content of the sea (PETROVA-KARADJOVA, 1973). During the years 1954-1970 the biomass of diatoms predominated over dinoflagellates (10:1). In the following years 1971-1980 the ratio of diatoms to dinoflagellates changed from 1 to 7 (PETROVA-KARADJOVA, 1984). The average annual biomass of diatoms and dinoflagellates shows that they are opposite, especially in the conditions of the anthropogenic eutrophication after 1970, which is the result of different types of nutrition (fig.1).

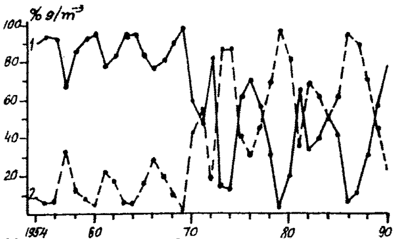

Fig.1.Percentage of mean annual biomass of diatoms(1)and dinoflagellates(2)of the phytoplankton in Bulgarian Black Sea coast

The cyclic influence of solar activity upon the diatoms, which have dual maximum development every 5,5-years in every 11-years cycle of the sun-spots (19th -21st cycles by the Zürich numeration) was proved though statistical and spectral analyses (PETROVA-KARADJOVA, APOSTOLOV, 1988). An opportunity for prediction was created for the present 22nd cycle, whose maximum was expected in 1990 (SOLAR GEOPHY-SICAL DATA, 1987) and the maximum of the diatoms - in 1991-1992.

The prognosis proved true earlier as the maximum of 22nd cycle began in 1989 (HIRMAN, GREER, SMITH, 1988) and remained at the same level till 1991, but the diatoms predomina-ted even in 1990 with an unequal development.

In the increasing organic pollution after 1970 "red tides" of *Prorocentrum minimum* (Pav.) Schill. appeared (MARASOVIC, PUCHER-PETKOVIC, PETROVA-KARAD-JOVA, 1990) which coincided with the maximum and minimum of the 21st cycle (1979 and 1986). It was found out that this type of influence was valid for the blooms of species, belonging to different taxa (PETROVA-KARADJOVA, 1990).

All the arguments on behalf of the concept of solar control upon the dynamics of the diatoms and other plankton alge are a reason to group the multiannual dynamics of phytoplankton species into periods corresponding to the periods of the solar cycles.

The period from 1956 to 1958 is known to have the greatest variety of species, followed by a depression till 1970, after that there is an increase of the number of species, in the years of the 21st and 22nd solar cycles, excluding the years of the blooms (1979 and 1986) (fig.2). The eutrophication enriches the phytoplankton with new species (now they are more than 200 total in comparison with only 162 in 1957, after the disappearance of the unsteady species in the Bulgarian area.

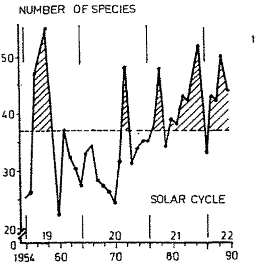

Fig.2.Dynamics of the phytoplankton in the years of solar cycles. Average level of the number of species in the quantitatives samples(---)

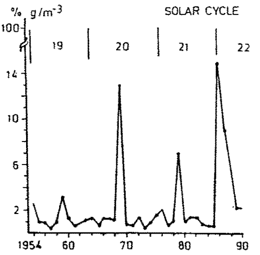

Fig.3.Cyclic dynamic/of the phytoplankton in average annual aspect by 11-years cycles of sun-spots(19-22)

The ratio between average annual biomasses of the phytoplankton along the Bulgarian Black Sea coast during 1954-1990 shows that it has two maximum developments in every 11-years cycles (fig.3): in 1959 (two years after the maximum of the 19th sun cycle, 1957) and in 1964 - in the minimum the 19th cycle; in 1969 (a year after the maximum of the 20th sun cycle, 1968) and in 1976 - in the minimum of the 20th cycle; in 1979 due to increasing organic pollution and "red tides" (in the maximum of the 21st cycle) and in 1986 (in the minimum of the same cycle).

These results prove the role of the solar control upon the multiannual dynamics of the phytoplankton in the Black Sea and give a chance for the prediction of the marine phytoplankton dynamics in the future.

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