EFFECT OF POLLUTION ON PHYTOPLANKTON SPECIES

Pia Elena MIHNEA
Romanian Marine Research Institute - Constantza (Romania)

Nous présentons les modifications qualitatives et quantitatives de la communauté phytoplanctonique, survenues à la suite du processus d'eutrophisation des eaux marines roumaines. Sur la base de celles-ci, sont effectuées des propositions sur les taxons que l'on peut considérer comme indicateurs de pollution.

The Romanian marine inshore waters are influenced by outfalls (domestic and industrial wastes) as well as by the Danube river waters. The modified physical and chemical factors act on the phytoplanktonic life cycle development.

The principal trophic anions increased their concentrations by ten and hundred times (MIHNEA & cowork., 1980). The maintainance of their concentrations at a rather constant level (the following data expressed in /ug-at l^{-1} are based on samples examined during 1980: $N\text{-}NO_2$ 0.1-2.9; $N\text{-}NO_3$ 1.8-21.8; $N\text{-}NH_4$ 0.96-40; $P\text{-}PO_4$ 0.48-864.51 sometimes up to 1,338.7 - the two latter values corresponding to an area influenced by industrial wastes), has induced certain peculiarities of phytoplanktonic species (MIHNEA & cowork., 1980).

The increase of some frequent, indigenous species density as a strong dominant component of the community.

1. Skeletonema costatum Grev.Cl. from $1x10^4$ - $4x10^6$ cell l^{-1} (1962-1965) to $8.26x10^7$ (1984) or $9.7x10^7$ (1975-1977).

2. Cyclotella caspia Grun. from $3.2x10^4$ - $1.2x10^7$ cell l^{-1} to $9x10^3$-$9x10^6$ $cell^{-1}$ (1975-1977).

3. Cerataulina bergonii Perag. reached a density of $3.58x10^5$ (1983).

4. Prorocentrum cordatum (Ostf.) Dodge from a few million (1962-1965) to $1x10^7$ - $1x10^8$ cell l^{-1} (1975-1983).

New species appeared in the ecosystem

a/ Species settled definitely or at least for an extensive period.

Gonyaulax polygramma Stein was found for the first time in the inshore waters of the Black Sea in 1976 at a density of $3.38x10^4$-$2.08x10^5$ cell l^{-1} and could reach $1x10^5$-$1.85x10^6$(1983) or $4.05x10^7$ cell l^{-1}(1977).

Raciborskiella salina Wislough developed at a density of $1x10^3$ - $1.4x10^4$ (1975) and also 1.04 - $1.7x10^6$ cell l^{-1}(1983 and 1977, respectively). One can suppose that their adaptation is due to one of the trophic ions whose concentration is maintained at a convenient level that sustains a good development.

b/ Species that after their accomodation have developed one or more life cycles and then their density was reduced or virtually desappeared from the ecosystem. The following species belong to this group: Polytoma uvella Ehr., Apiococcus consociatus Korschikoff, Brachiomonas westiana Pasher, Chloromonas paupercula (Playfair) Gerloff und Ettl., Chaetoceros simplex var. calcitrans Pauls.

They are supposed to be introduced in the ecosystem by a factor whose concentration decreased or was inhibited by other environmental factors (detergents, pesticides, heavy metals, etc.).

The dependence on temperature was diminished by the trophic ions concentrations so that it was possible for some species to be present throughout the year.

Observations performed in the natural environment as well as in experiments (MIHNEA & VOINESCU, 1979) have shown that high level of nutrients produced a massive development of Chaetoceros simplex var. calcitrans at summer temperature.

The availability of nutrients modified the life cycle of Skeletonema costatum and Cyclotella caspia (MIHNEA, 1980); these species were present in the water mass throughout the year. There was an alternation of two vegetative cycles and two sexual reproductive cycles during the year of massive development of Skeletonema costatum (1977). It was possible that the frequency of the biological cycle to be 2-3 times higher (1976) when the species bloomed.

The reproductive cycle of Cyclotella caspia consisted of two direct division cycles and a sexual reproduction cycle. The result of an increase in biological life cycles is the high cell density reached by the species.

The remaining species of the natural succesion can become the new dominant element in an area supplied by an outfall. Skeletonema (e.g.) reduced its density after a mass development or a bloom, but could increase again the cell density for a long period: 1.26×10^7 cell l^{-1} in July 1982 within Constantza harbour, and 7.76×10^7 cell l^{-1} in May 1982, close to an industrial outfall mainly containing $P\text{-}PO_4$.

High quantity of organic dissolved matter (it is usually over 30 mg $KMnO_4\, l^{-1}$), its nature (BOD_5 ranged between 0.69 to 13.44, sometimes higher), the tendency of pH increase over 8 in these conditions, as well as a low salinity (15.18-9.8 gS‰ or lower) favoured the development of euglenophytes.

Eutreptia lanowii Steur. was identified in environments with values of 5 day BOD which varied within the range of 2.4-4.6 $mgO_2\, l^{-1}$ (MIHNEA, 1978a). The maximum cell density reached by the species was up to 8.1×10^6 cell l^{-1} (1982) in the Constantza harbour waters.

Other representatives of euglenophytes: Euglena pisciformis Klebs., E. viridis f. salina Popova, E. acus Ehr., E. desses Ehr., E. limnophyla Lemm., E. convoluta Korsch., Distigma proteus Ehr., D. curvata Pringsh., D. curvata f. major Pringsh., Astasia parvula Skuja, A. pygmaea Akuja, A. ocellata Khawkine, A. curvata Klebs, etc., developed to a BOD_5 ranging between 2 and 7 $mgO_2\, l^{-1}$ (MIHNEA, 1978b) being correlated with the quality of dissolved organic matter.

From these personal observations as well as from those of other authors, one can conclude:

1. Indicator species can be considered those algae that are able to produce blooms or massive developments; they are usually cosmopolitan or at least widely spread. Skeletonema costatum, Nitzschia seriata Cl. and Gonyaulax polygramma are common, in a high density, for the Black Sea and for the Adriatic too (PUCHER-PETKOVIČ & MARASOVIĆ, 1980); Skeletonema and Nitzschia are similarly noted for the Gulf of Panama (SMAYDA, 1965).

2. Species that underwent an expansion of their biological cycle and represented constantly over 10% from the total individuals of the community, could also be reckoned among indicators.

3. The heterotrophic and autotrophic consumers of dissolved organic matter must be considered as indicator species, too, although they could be found under 10% of the total number of individuals of the community. They are indicators of the water mass polluted by domestic wastes.

4. The indicator species are different as they belong to different geographic latitudes but the difference is mainly due to the category of pollution factors they depend on.

BIBLIOGRAPHY

MIHNEA P.E., 1978 a - Qualitative and quantitative characteristics of the alga Eutreptia lanowii Steur. in the relation to the coastal pollution phenomenon.

MIHNEA P.E., 1978 b - Euglénacées et Chrysophycées en tant qu'organismes entraînés dans la pollution marine littorale. IV^{es} Journées Etud. Pollutions, 471-475, Antalya, CIESM.

MIHNEA P.E. and VOINESCU I., 1979 - Utilization of the principal trophic anions by the marine unicellular algae as a function of the specific environmental conditions. Cercet. Mar. IRCM, 12: 53-80.

MIHNEA P.E., 1980 - Reproductive cycle of Skeletonema and Cyclotella modified by chemical changes in the Black Sea. V^{es} Journées Etud. Pollutions, 863-868, Cagliari, CIESM.

MIHNEA P.E., CUINGIOGLU E. and BILAL I., 1980 - Modifications des communautés phytoplanctoniques littorales sous l'influence du phénomene de pollution. V^{es} Journées Etud. Pollutions, 869-876, Cagliari, CIESM.

PUCHER-PETKOVIĆ T., MARASOVIĆ I., 1980 - Développement des populations phytoplanctoniques caractéristiques pour un milieu eutrophisé (baie de Kastela, Adriatique centrale). Acta Adriatica, 21, 2: 79-93.

SMAYDA T., 1965 - A quantitative analysis of the phytoplankton of the Gulf of Panama. III On the relationship between C^{14} assimilation and the diatom standing crop. Inter. Amer. Tropical Tuna Comiss. Bull., 9, 7: 467-531.