Thermal influence of thermoelectric power station "Varna" on Varna Lake ecosystem and ecological impact.

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Varna lake is a brackish lake (mean salinity 16‰) with intensive water exchange with the sea through two channels. As an area where the greatest portion of the industrial and sewage waste waters of Varna region are discharged, it is the main source responsible for the high level of eutrophication and pollution of Varna Bay with strong ecological impact on the marine biota. (MONCHEVA, 1991).

The operational phase of the Thermoelectric Power Station (ThPS) "Varna" situated on north Varna lake coast started in 1967. The once-through cooling circuit is based on deep layers cold water intake by pumps and discharge back to Varna lake system through two channels (Fig.1). At full power the cooling water temperature in the circuit is about 40°-46°C and depending on the season at the discharge points between 27° and 20°C. The investigations are focused on ThPS "Varna" temperature pattern influence assessment and its ecological impact.

The parameters taken into consideration are temperature, salinity, current speed and direction, phytoplankton analyses in qualitative and quantitative terms, (abundance and biomass, chlorophyll "a" and phaeophytin) seasonally during 1990 - 1991 and detail investigations in May 1991.

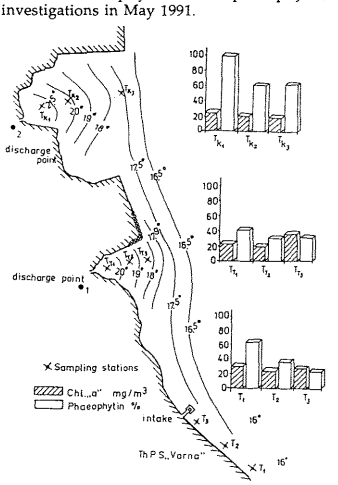

Fig.1. Trends in temperature, chl. "a" and phaeophytin distribution from the closed to discharge points areas.

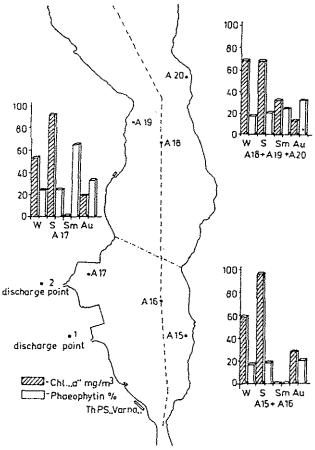

Fig.2. Seasonal pattern of chl."a" and phaeophytin distribution in Varna lake: w - winter; s - spring; sm - summer; au - autumn.

The data reveal that the thermal plume influences an area of $9.2x10^5$ m^2 (e.g. 1/4 of the total surface of Varna lake) down to 5m depth, resulting in a local temperature water mass gradient varying between 6 and 10°C (depending on the season) - fig.1.

The discharged water impact includes both oceanographic and biological perturbations of the ecosystem (although restricted mainly to its western part) :

- the temperature gradient induced changes in the stratification of the basin affect water mass circulation and density, resulting in the formation of a horizontal pressure gradient and water mass dynamic processes activation in the area of concern (especially in winter, spring and autumn).

- perturbation in the pattern of development of phytoplankton: significant differences in quantitative terms between the impact (st. A17, A16, A15) and relatively distant areas (st. A18, A19, A20) while the taxonomic structure is almost the same - the main trend being a shift in both chl."a" and phaeophytin in the area of concern (fig.2). As it is known t° increase influences phytoplankton development in several ways: stimulates colonization rate, determines to a greater extent in excystment, generation time and life cycle duration (EPPLEY, 1972, STEIDINGER and HADDAD 1981).

Probably the induced increase in the temperature of closed area waters may serve as a potential initiation factor responsible for high phytoplankton biomass maintenance and conditioning phytoplankton blooms inoculating the whole area through dynamical processes under the high eutrophication level of the environment.

The detailed map of phaeophytin distribution investigation reveals very high values (between 75 - 93 %) at the very close to the discharge points zone slightly decreasing towards the 16° isotherm (fig.1). The high phaeophytin % can not be related to the direct temperature impact (the summer temperature exceeds 26°C). As the temperature of the water in contact with the condensors is 40 - 46°C, it is high enough to cause the death of the living plankton cells to which the mechanical treatment contributes a lot. Taking into account that the mean year phytoplankton biomass is 24.9 mg/l, each pump capacity (250 m^3/h) and average phaeophytin (77 %) it is estimated that the input of fresh - dead phytobiomass amounts to 12kg per fortnight, e.g. 4.4 t per year. The dead matter if not utilized through the food web sinks directly to the bottom.

The excess of phytobiomass produced as a result of the high eutrophication level of Varna Lake (ROJDESTVENSKI, 1991), and the high input dead matter rate induced by the thermal operating cycle of the station create conditions leading to the deterioration of benthic cenoces through a decrease of water transparency, a mechanical overlapping and an oxygen deficiency. As established the benthic cenoces at st. A17 are totally dead and seriously damaged at st. A16, A15 (KONSULOVA, 1991).

The results of the complex investigations give ground to consider the thermal influence of ThPS "Varna" on Varna Lake system as a thermal pollution with strongly expressed indirect negative ecological impact although it is not the only reason responsible of the ecological disaster of the basin.

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