ISSN 1314-3379

EVOLUTION OF HYDROLOGICAL AND HYDROCHEMICAL PARAMETERS IN THE VARNA BAY

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Abstract: *Water is regarded as a sector of growing importance for Europe. Worldwide water is under increasing pressure owing to demographic growth and urbanization, increasing globalization, and climate change. To achieve the sustainable use and development of natural water resources is a challenge for both global and local communities. This paper provides evolution of essential characteristics of the Varna Bay water environment concerning the north area, considering the previous long-term environmental studies.*
Keywords: *,Hydrocemistry,Hydrology, natural water resources, water environment,Varna Bay.*

Introduction

Water is regarded as a sector of growing importance for Europe.

Worldwide water is under increasing pressure owing to demographic growth and urbanization, increasing globalization, and climate change.

In urban coastal areas, especially large or densely inhabited ones, specific issues raise with regard to natural water management. Water resources are often managed locally. Management of natural water resources needs to be efficiently secured or, where necessary, improved. Only through a paradigm shift from fragmented towards integrated urban coastal water management economic development, social balance and ecological integrity can be secured. Management of urban coastal water can be complex because of the interaction with the different components of urban-systems and with urban land management. Diagnosis, decision support and management tools need to offer solutions from real time to long term, and to integrate multiple stakes and aspects. Integrated coastal water management has to include water environment management and conservation, sustainable development, water infrastructure sustainability, safeguarding health and survival of the marine life.

To achieve the sustainable use and development of natural water resources is a challenge for both global and local communities. It requires commitments from all groups within international, national and local communities from their, possibly conflicting, perspectives. Without a set of coherent arrangements, designed to ensure effective governance of the water resources, their sustainable use and development is unlikely to be achieved.

In this context, the paper provides evolution of essential characteristics of the Varna Bay water environment concerning the north area, considering the previous long-term environmental studies [7].

Material and Methods

Sampling was performed weekly in the north area of the Varna Bay (the former bridge) in 2001. As this area is shallow, samples were taken only from surface water.

The study is a continuation of the investigations of the Varna Bay water environment in the north area over 1992-2000 [7].

Results and Discussion

Monthly dynamics of temperature in the north area of the Varna Bay over both 1992-2000 and 2001 is represented in Figure 1. In 2001, sea surface temperature (SST) minimum of 6.03 ˚C has come in February and was with 1.3 ˚C higher than over 1992-2000. Sharp warm of the sea water has occured from April to May - from 9.10˚C to 14.94 ˚C. June was cool, with SST 14.98 ˚C. Over 1990s, the winters were gradually becoming warmer, the springs colder [4]; [5] and this tendency has continued in 2001.

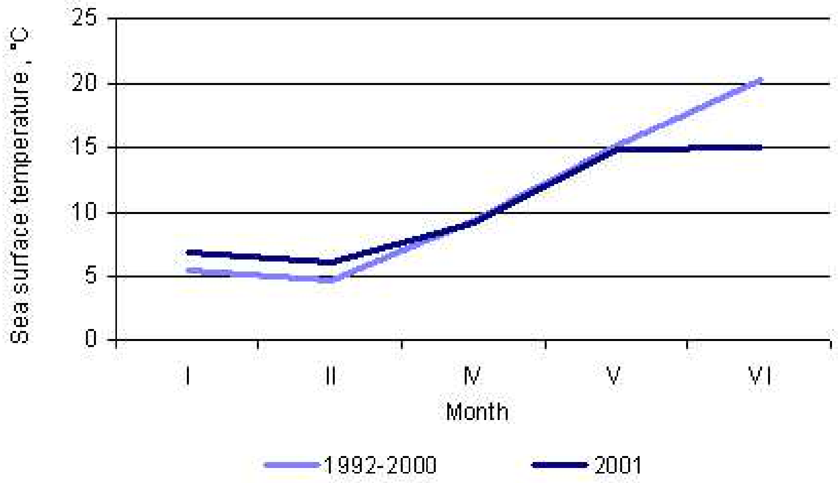

Figure 1. Sea surface temperature (˚C) in the north area of the Varna Bay over both 1992-2000 and 2001

Figure 2 produces monthly dynamics of sea surface salinity (SSS) in the north area of the Varna Bay over both 1992-2000 and 2001. The absolute amplitude's maximum of the annual salinity variability is in the surface waters [16]; [14]; [4]; [7]. Like 1990s, due mainly to increased Danube's discharge, and rains and slight seawind as well, strong annual drop in sea surface salinity (SSS) has occurred in May - 15.31 psu. SSS was high in January, February, and June: 17.09 - 17.38 psu. With exception of May, sea surface salinity was higher compared to 1990s - up to 1.17 psu in June.

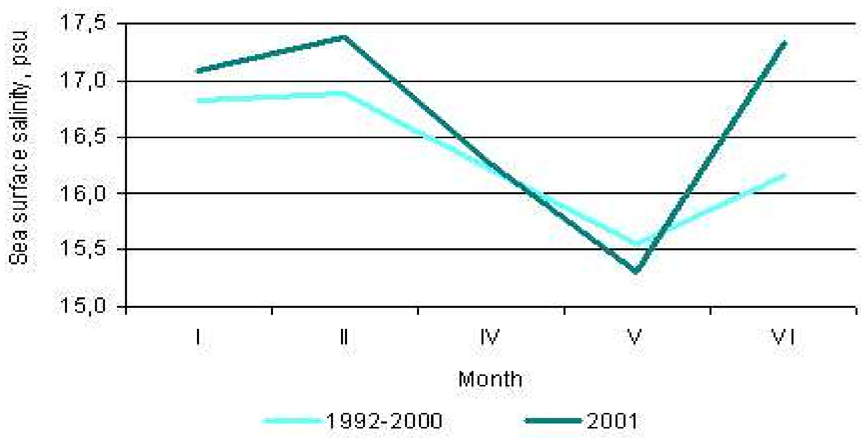

Figure 2. Sea surface salinity (psu) in the north area of the Varna Bay over both 1992-2000 and 2001

Generally, Figure 6 presents reverse correlation between sea surface temperature and sea surface salinity. The Danube's runoff [9]; [3]; [17]; [10]; [11]; [2]; [18], which is the main affecting factor on the Varna Bay's salinity, increases by 1.5 times in the spring [12]; [8]. The increase in temperature and accordingly the melting of snows and ices in the vast Danube's catchment area cause minimum of Varna Bay's salinity in May.

Monthly dynamics of dissolved oxygen in the surface water of the north Varna Bay area is presented in Figure 3. The peak dissolved oxygen concentration - 7.46 ml.l^{-1} was in conformity with the temperature minimum in February (Figure 6). From February to June, the dissolved oxygen has gradually decreased to 5.83 ml.l^{-1}. The dissolved oxygen concentration in 2001, controlled mainly by the biochemical process respiration, was reduced compared to 1992-2000.

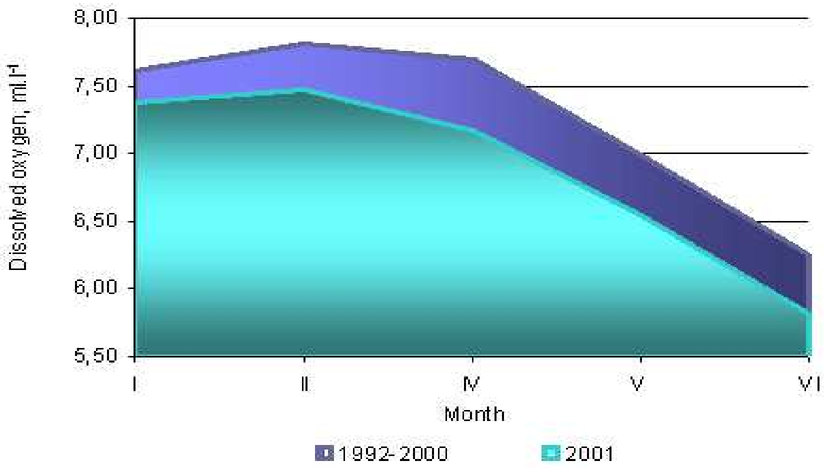

Figure 3. Dissolved oxygen (ml.l^{-1}) in the surface water of the north area of the Varna Bay over both 1992-2000 and 2001

Oxygen saturation changes are mainly depending on changes of temperature and salinity, waters mixing, biological factors, as well as some chemical processes [6]. Like 1990s, the May oxygen saturation maximum of 98.74 % has come in the period of salinity minimum (Figure 6). Significantly reduced oxygen saturation to 89.21 % has occurred at increased consumption of O_2 in June.

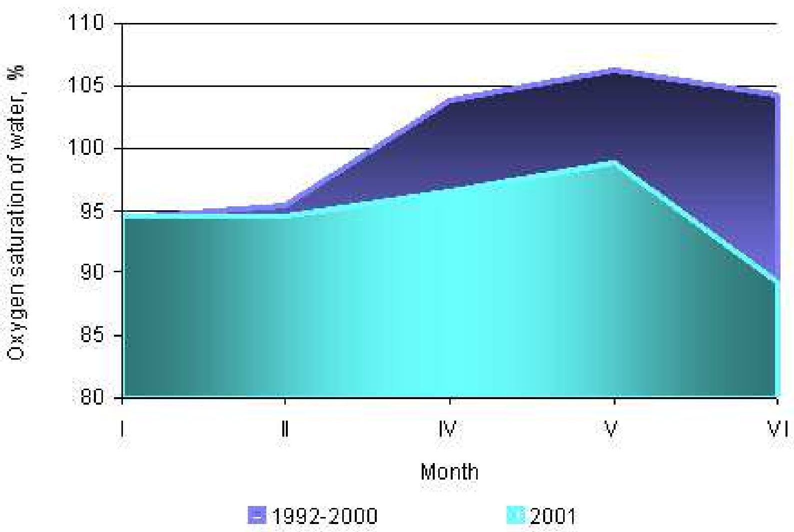

Figure 4. Oxygen saturation (%) in the surface water of the north area of the Varna Bay over both 1992-2000 and 2001

Organic matter in water can be assessed by chemical oxygen demand (COD)-Mn [1]; [15]; [13]. Figure 5 produces the monthly dynamics of COD-Mn in neutral medium, with ranging from 1.14 $mgO_2.l^{-1}$ (February) to 2.10 $mgO_2.l^{-1}$ (May). At average, the organic matter in 2001 was on a level with 1997-2000.

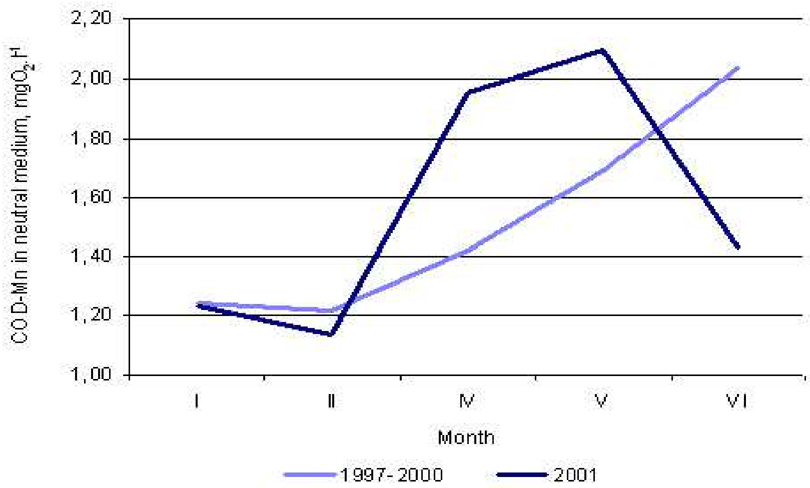

Figure 5. COD-Mn in neutral medium ($mgO_2.l^{-1}$) in the surface water of the north area of the Varna Bay over both 1997-2000 and 2001

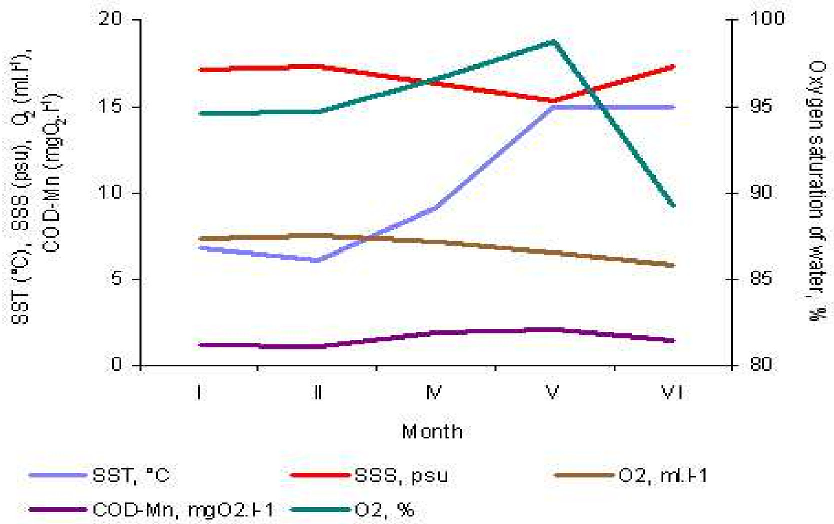

Figure 6. Sea temperature (˚C), sea salinity (psu), dissolved oxygen ($ml.l^{-1}$), oxygen saturation of water (%), and COD-Mn in neutral medium ($mgO_2.l^{-1}$) in the surface water of the north Varna Bay area in 2001

Conclusions

In 2001, sea surface temperature minimum has come in February and was with 1.3 ˚C higher than over 1992-2000. Sharp warm of the sea water has occured from April to May. June was cool.

Over 1990s, the winters were gradually becoming warmer, the springs colder and this tendency has continued in 2001.

Like 1990s, due mainly to increased Danube's discharge, and rains and slight seawind as well, strong annual drop in sea surface salinity has occurred in May. The SSS was high in January, February, and in June. With exception of May, sea surface salinity was higher compared to 1990s - up to 1.17 psu in June.

Generally, there is reverse correlation between sea surface temperature and sea surface salinity. The Danube's runoff, which is the main affecting factor on the Varna Bay's salinity, increases by 1.5 times in the spring. The increase in temperature and accordingly the melting of snows and ices in the vast Danube's catchment area cause minimum of Varna Bay's salinity in May.

The peak dissolved oxygen concentration was in conformity with the temperature minimum in February. The dissolved oxygen has gradually decreased from February to June. The dissolved oxygen concentration in 2001, controlled mainly by the biochemical process respiration, was reduced compared to 1992-2000.

Like 1990s, the May oxygen saturation maximum has come in the period of salinity minimum. Significantly reduced oxygen saturation has occurred at increased consumption of O_2 in June.

At average, the organic matter in 2001 was on a level with 1997-2000.

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