Monitoring the oxygen level in the Szarvas-Kákafok Deadarm

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SUMMARY

The water quality of the Szarvas-Békésszentandrás Dead Körös is generally meso-eutrophic, and meso-saprobic. However, particularly under higher temperature conditions, the water body may change toward the eutrophic state, even algal blooms could be observed previously.

The present measurements were conducted during a two week period, twice a day. Three water samples were taken horizontally, from the surface, bottom and the middle of the water body. The samples were examined in situ. The oxygen content, the temperature, the pH and the conductivity were measured by potentiometric methods.

Increasing pH was detected in correlation to the temperature, which indicated a rising photosynthetic activity. Also, the O_2 concentration showed high variations, especially, when the fresh water supply from the river was stopped, due to a small flood in the river Körös.

These results indicate the increasing eutrophication processes in the deadarm, and the high load and instability of the ecosystem.

INTRODUCTION

The Szarvas-Békésszentandrás Holt Körös ("Kákafok Deadarm") is the biggest deadarm of Hungary. Its basin area is 927 km^2. The overall length is 29.2 km, the average width is 71 m, the surface area is 207 ha, the average water depth is 2.2 m, and the water quantity is 4.5 million m^3. The water quality is generally meso-eutrophic, and meso-saprobic (Pálfai, 2001).

The oxbow-lake has multiple utilizations. The most significant utilization is agricultural: The water is used for fish culture, for irrigation and for inland water reservoir as well. Also, it has an important role, as a diversion reservoir. Finally, the oxbow-lake has a significant recreational role. However, particularly under higher temperature conditions, the water quality changes toward the eutrophic state, even algal and macrophyte bloom could be observed.

In order to preserve the water quality, the deadarm has continuous water supply from the river Körös.

The European Union Water Framework Directive states that the surface and groundwater bodies should achieve good status by 2015. Therefore, monitoring the water quality is an important task. The potentiometric measurements give us quick and continuous monitoring possibilities in the field. The oxygen line, the pH and the conductivity variations in the water body indicate the quick response of the ecosystem to the environmental influences. Our goal was, to follow the immediate responses, and therefore, to estimate the ecological state of the deadarm.

MATERIALS AND METHODS

Sampling

The measurements have been conducted in 2010 for two weeks, twice a day; in the morning and in evening.

The samples were taken by a one liter measuring flask with length marks.

Three water samples were collected horizontally, from the littoral zone, from the mid section, and from the centre line of the deadarm. The depths of the water body were 1 m, 2.4 m and 4 m. From the littoral zone the samples were collected from the surface and the bottom water body, while surface, middle part and bottom water samples were collected from the mid section and the centre line of the deadarm. The samples were measured immediately after the sampling in the flask, in order to obtain *in situ* data.

Experimental methods

The oxygen content was measured by a WTW OXI 330 oxygen meter.

The pH was recorded with a THERMO ORION 3STAR pH meter.

The temperature and the conductivity was followed by a TOA CM-21P conductivity meter

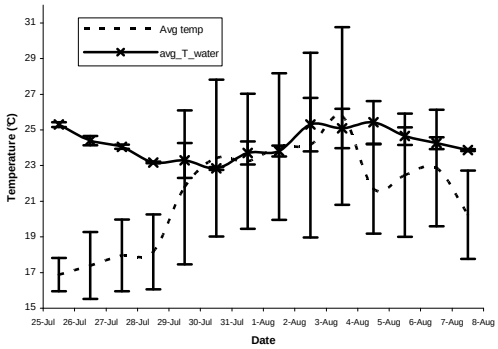
The meteorological temperature data were obtained from the Szarvas meteorological station.

RESULTS AND DISCUSSION

Variation of the temperature

During the measurement period diverse weather conditions were detected. The daily average temperature and its standard variation was calculated (*Figure 1*). The lowest temperature was on 25th July, and the highest was on 4th August. The air temperature showed high daily variations, which are indicated by the high STD values. The changes in the water body were more balanced, however the highest temperature reached 27.1 °C. The low STD values indicate, that thermocline has not formed, even in the 4 m deep centre line section. Therefore, the oxbow-lake can be classified as shallow lake (Water Framework Directive, 2000).

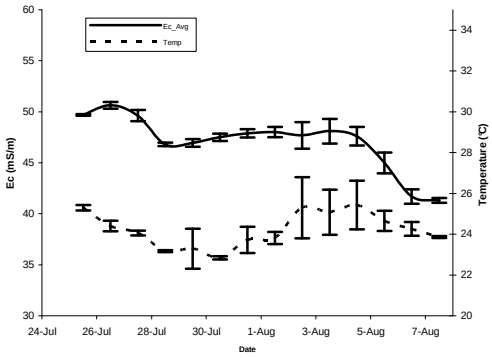
Figure 1: **Comparison of the daily average temperature of the air and water body. The bars indicate the standard deviation.**



Variation of the conductivity

The conductivity did not showed significant variations, the average values remained between 40.2 and 50,1 mS/m. Also, the standard deviations remained below 1.30. The small decrease can be explained with the water refreshment from the river Körös (*Figure 2).*

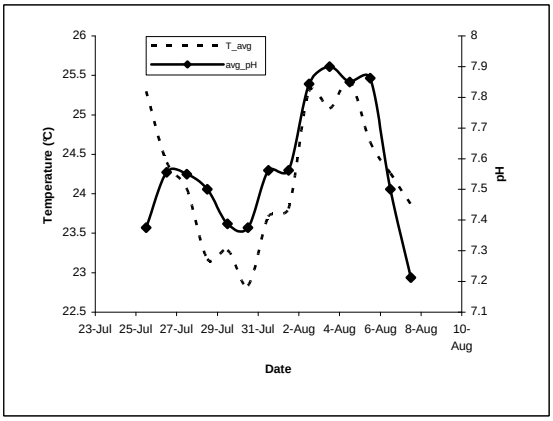
Figure 2: **The changes in the average conductivity, compared to the water temperature. The Ec showed the effect of the external water refreshing.**



Variation of pH

At a previous observation in 2008, extreme high pH was detected, which reached the 10.3 value. The present measurements support its possibility. As the water temperature started to rise, it led to an increasing photosynthesis, which lowered the CO_2 and HCO_3^- content of the water. Eventually it was showed in an increased pH *(Figure 3*). These results are well correlated with the observation of Schwoerbel (1999), who measured daily variations with pH 9 peak in mountain springs.

Figure 3: **The changes in the average pH, compared to the water temperature. The variations of pH followed the temperature changes.**

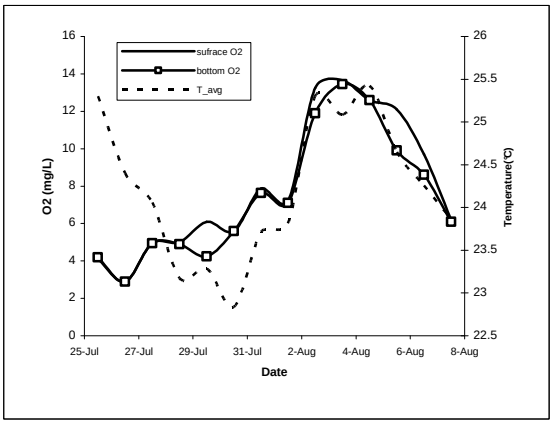


Variation of the oxygen content

Although the deadarm is continuously supplied by fresh water from the river Körös, under extreme circumstances it could be stopped. Due to a smaller flood on the river the deadarm was closed between 30th July and 3rd August. As the very slow stream stopped, it dramatically changed the oxygen relations in the water body.

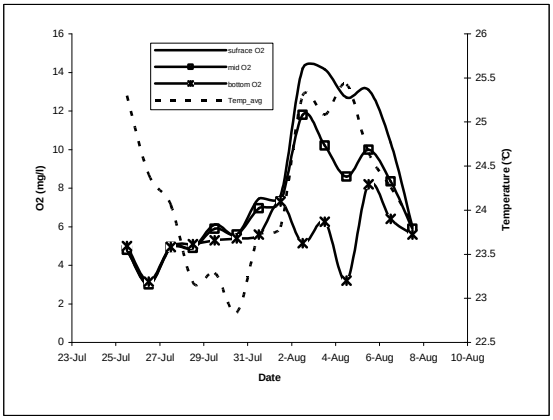
In the littoral zone the oxygen content increased due to a photosynthetic activity and a still water. However the diffusion in the 1 m water body was able to supply sufficient O_2 in the bottom layer (*Figure 4*).

Figure 4: **Changes of the average O_2 in the littoral zone, compared to the water temperature. The oxygen variation was similar in the surface and bottom layer, and followed the temperature changes**



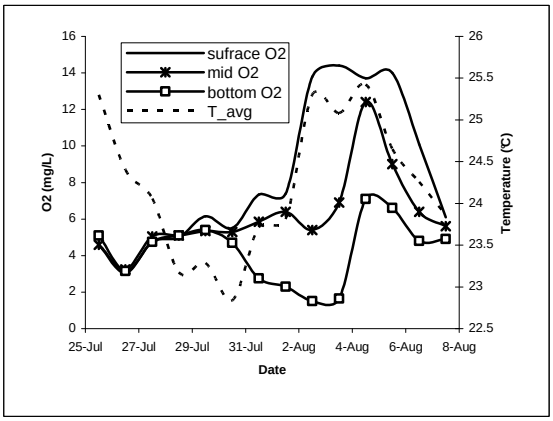
In the mid section the water was 2.4 m deep. While the constant stream supported sufficient mixing effect, in the still water oxygen stratification started with the higher temperatures and higher photosynthesis (*Figure 5*). After the flood, the oxygen content decreased, but was more balanced in all depth.

Figure 5: **Changes of the average O_2 in the mid section, compared to the water temperature.**



In the deepest centre line region the changes were more dramatic. On the surface the O_2 level reached the 18.2 mg/l value, while in the bottom layer decreased to 1 mg/l (*Figure 6*). After the water supply the O_2 content remained at 5 mg/l level.

Figure 6: **Changes of the average O_2 in the centre line of the deadarm, compared to the water temperature.**



Summarized, these results indicates that the Szarvas Kákafok oxbow-lake ecosystem became highly instable, which may indicate the overload of the water body. Kud-Hansen et al. (1998) states, that in the fish ponds the oxygen content does not decreases below 3 mg/l, if the organic matter production is autochtonous. However, if the temperature rises for a longer period in the deadarm, the variation of the pH and the oxygen content may reach extreme conditions. The 1 mg/l concentration could be dangerous for the higher organisms (Horváth, 2000). These results also indicate the advanced eutrophication state of the deadarm. The continuous water supply from the living river is essential for the health of the water body. However, in long term circumstances, the nutrient load should be effectively decreased

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