

RESULTS OF PHYSICAL AND CHEMICAL PARAMETERS MONITORING OF THE “RÂUL MARE” RIVER★

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The values of the physical and chemical parameters of the “Râul Mare” river, which is the most important affluent of the Cibin river, were monitored and the detailed results are presented. The results also reveal that the Belgian index indicates a moderate ecological status of the river.

Key words: physical parameters monitoring, pollution.

1. INTRODUCTION

The “Râul Mare” river is the most important affluent of the Cibin river. It springs from the Iezerul Mare glacial lake in the Cindrel mountain. The study that is described in this work was conducted primarily to assess the changes produced by human activities on lotic ecosystems. The values of the physical and chemical parameters represent an important monitoring tool of the ecological status and of the quality of the water that flows into the “Gura Râului” lake, which is the main fresh water source for the Sibiu city.

The physical and chemical parameters that were monitored were: the temperature, the total amount of suspension, total water hardness, temporal water hardness, permanent water hardness, the total solids in suspension, the total dissolved solids, the amount of dissolved oxygen. The monitoring was conducted from March to November 2006. The details of the field and laboratory procedures are presented in the next section.

2. MATERIALS AND METHODS

In order to evaluate the effect of human activities on lotic ecological systems, river water from several places were selected. Different physical and

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chemical parameters that were monitored are presented in the following subsections.

2.1. THE WATER TEMPERATURE, THE ACIDITY AND DISSOLVED OXYGEN

Among the physical parameters that were monitored, the water temperature, the acidity and the amount of dissolved oxygen were measured in situ using a portable digital MultiLine pH-OXI [1]. Like terrestrial animals, fish and other aquatic organisms need oxygen to live. As water moves past their gills (or other breathing apparatus), microscopic bubbles of oxygen gas in the water, called dissolved oxygen (DO), are transferred from the water to their blood. Like any other gas diffusion process, the transfer is efficient only above certain concentrations. Oxygen can be present in the water, but at too low a concentration to sustain aquatic life. Oxygen also is needed by virtually all algae and all macrophytes, and for many chemical reactions that are important to water ecosystem functioning. Dissolved oxygen concentrations are most often reported in units of milligrams of gas per liter of water – mg/L, which is equivalent to parts per million = ppm.

Another physical parameter that strongly dictates the quality of water is the oxygen deficit. It can be calculated as $100\% - \text{oxygen saturation}$. Oxygen saturation is calculated as the percentage of dissolved O_2 concentration relative to that when completely saturated at the temperature of the measurement depth. We must bear in mind that as temperature increases, the concentration at 100% saturation decreases.

The elevation of the lake or river, the barometric pressure, and the salinity of the water also affect this saturation value but to a lesser extent. In most river waters, the effect of dissolved solutes (salinity) is negligible; but the elevation effect due to decreased partial pressure of oxygen in the atmosphere is about 4% per 300 meters. The DO concentration for 100% air saturated water at sea level is 8.6 mg O_2 /L at 25°C and increases to 14.6 mg O_2 /L at 0°C. The chart in Fig. 1 was used in calculating saturation [2] and that the oxygen deficit can be calculated as $100\% - \text{oxygen saturation}$.

Streams with a saturation value of 90% or above [2–5], hence an Oxygen deficit of less than 10% or less are considered healthy, but this course is only one measure of the “health” of an aqueous ecosystem.

The monthly average values that were measured during March to November 2006 time period of the temperature, dissolved oxygen, DO and Oxygen deficit, calculated as above and corrected with altitude area are presented in Table 1. Fig. 2 presents the monthly water temperature average over the monitoring time.

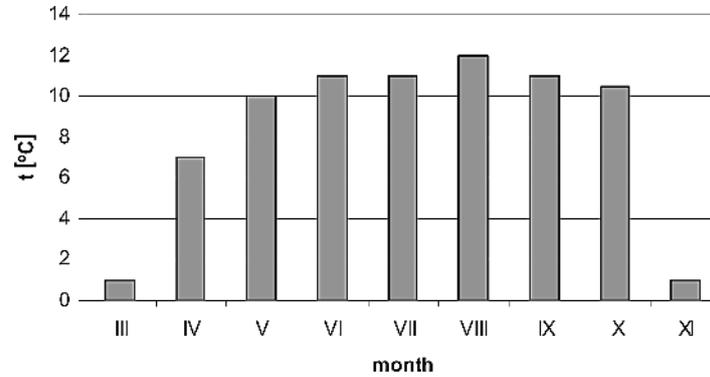


Fig. 2 – The monthly water temperature average during March–November 2006.

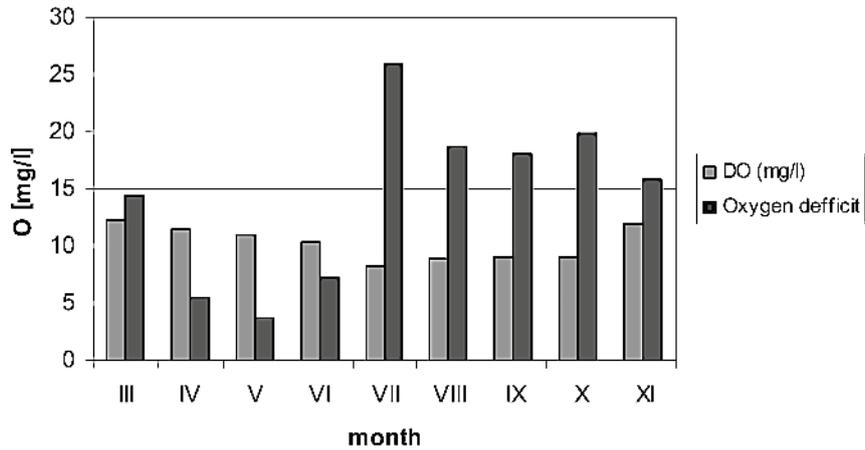


Fig. 3 – The dissolved oxygen amount variation during the monitoring period.

2.2. WATER HARDNESS

Another parameter that is taken into account when establishing the health status of river water is the hardness of the water. Hard water is water that has a high mineral content (water with a low mineral content is known as soft water). This content usually consists of high levels of metal ions, mainly calcium (Ca) and magnesium (Mg) in the form of carbonates, but may include several other metals as well as bicarbonates and sulfates. It is not generally dangerous but certain studies found an influence of the water hardness on the cardiovascular diseases and mortality [6–9].

Water hardness usually measures the total concentration of Ca and Mg, reported as ppm w/v (or mg/L). Ca and Mg are the two most prevalent divalent metal ions, although in some geographical locations iron, aluminium, and manganese may also be present at elevated levels. Calcium usually enters the

water from either CaCO_3 , as limestone or chalk or from mineral deposits of CaSO_4 . The predominant source of magnesium is dolomite, $\text{CaMg}(\text{CO}_3)_2$. The variation of the river water Ca and Mg monthly average concentrations are presented in Table 1 and in Fig. 4.

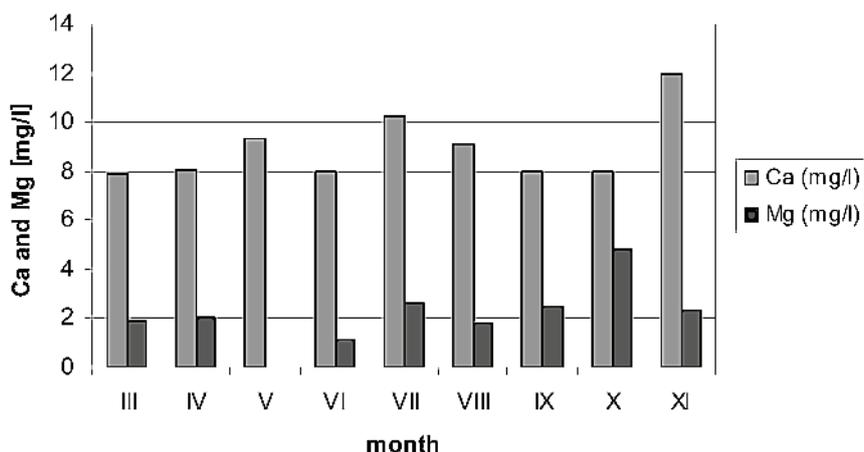


Fig. 4 – Ca and Mg monthly average concentrations.

The precise mixture of minerals dissolved in the water, together with the water's acidity (pH) and temperature will determine the behaviour of the hardness, therefore a single number on a scale does not give a full description. A descriptions of hardness correspondind roughly with ranges of mineral concentrations is presented below:

- Soft: 0–20 mg/L as calcium
- Moderately soft: 20–40 mg/L as calcium
- Slightly hard: 40–60 mg/L as calcium
- Moderately hard: 60–80 mg/L as calcium
- Hard: 80–120 mg/L as calcium
- Very Hard >120 mg/L as calcium.

Total water hardness includes both Ca^{2+} and Mg^{2+} ions and is expressed as DT in Table 1. Temporary hardness is hardness that can be removed by boiling or by the addition of lime (calcium hydroxide). It is caused by a combination of calcium ions and bicarbonate ions in the water. Boiling, which promotes the formation of carbonate from the bicarbonate, will precipitate calcium carbonate out of solution, leaving water that is less hard on cooling. The amount that can be removed in this way is called temporary hardness and is expressed as Dt in Table 1. Permanent hardness, expressed as Dp in Table 1, is hardness (mineral content) that cannot be removed by boiling. It is usually caused by the presence of calcium and magnesium sulfates and/or chlorides in the water, which become

more soluble as the temperature rises. The total, temporal and permanent water hardness are expressed in German degrees. One degree German ($^{\circ}\text{dH}$ or $^{\circ}\text{G}$) corresponds to one part calcium oxide in 100,000 parts of water. In order to convert to mg/L calcium the value has to be divided by 0.14.

The Ca and Mg monthly average concentrations are presented in Table 1.

Examining Table 1 we find that the water of the Râul Mare river is a soft water, as it flows mainly on basalt rock.

2.3. THE SUSPENDED AND DISSOLVED SOLIDS

Other physical parameters that were monitored were the total suspended solids and the total dissolved solids. Total suspended solids is a water quality measurement usually abbreviated TSS [10–11]. This parameter was at one time called non-filterable residue (NFR), a term that refers to the identical measurement: the dry-weight of particles trapped by a filter, typically of a specified pore size. In other disciplines (Chemistry and Microbiology for examples) and dictionary definitions, “filterable” means just the opposite: the material passed by a filter, usually called “Total dissolved solids” or TDS. Thus in chemistry the non-filterable solids are the retained material called the residue. TSS of a water sample is determined by pouring a carefully measured volume of water (typically one liter; but less if the particulate density is high, or as much as two or three liters for very clean water) through a pre-weighed filter of a specified pore size, then weighing the filter again after drying to remove all water. The gain in weight is a dry weight measure of the particulates present in the water sample expressed in units derived or calculated from the volume of water filtered (typically milligrams per liter or mg/l). The values of the monthly average TDS and TSS are presented in Table 1.

The Fe and heavy metals concentration in the Râul Mare river water were monitored as well. Their concentration is below the maximum admitted values in Romania [12].

CONCLUSIONS

The physical and chemical parameters monitoring of the Râul Mare water was carried on during March–November 2006. The results reveal that the dissolved oxygen amount is high, ranging in between 8.21 and 12.20 mg/l, the average oxygen deficit was 14.35%, which means that, in respect of this parameter, the river water can be considered to be in a good health state. The oxygen deficit increases during the hot months, which is a normal result, as the amount of dissolved oxygen decreases with the increase of the temperature.

The water hardness was another parameter that was investigated. Examining Table 1 we notice that the average Ca concentration was 8.92 mg/l, which makes the Râul Mare water a soft water.

Other physical parameters that were monitored were the total suspended solids and the total dissolved solids. The TSS and TDS parameters were found to be below the maximum admitted values according to the Romanian standards.

The Fe concentration is below the maximum admitted values according to the Romanian standards, as well, and the heavy metal concentration is below the detection threshold.

Overall, the results of this monitoring reveal that the health status of the Râul Mare river water is very good because of the natural cleansing process and because there does not exist any significant pollution source on the river.

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