QUALITY OF SURFACE WATERS STABILITY IN MEADOW ECOSYSTEMS

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Surface water flowing through river-beds contains a great amount of dissolved inorganic and organic substances. The basic chemical composition of great streams changes depending on discharge and climate. In all streams, where mineral chemical composition was measured, calcium ions are predominant. The mean concentration of substances dissolved in surface waters is approximately 120 mg/l. The concentration of components in surface water, in descending order, is, as a rule: Ca, C, Cl, Na, Mg, Si, S, K and N.[1] Many of these elements have an important role as biogenic elements. They are essential elements for the physiological functions of plant species.

The surface water of nine Danube channels in the Gabcikovo waterworks region was sampled. Elements measured included Ca, Mg, K, Na, SO4, NO3, NH4, F, pH, dissolved substances and electrical conductivity. Base cations were determined by atomic absorption spectrophotometry, sulphates by titrimetric methods, nitrate was determined by ion-selective electrodes, ammonium and fluorine by colorimetry, pH was analysed potentiometrically, dissolved substances gravimetrically and electrical conductivity was determined conducto-metrically. The results of the surface water analysis and some of their mathematical/statistical characteristics are presented in tables 1 and 2.

Table 1. Ca, Mg, K, S and N concentration in mg/l

	Ca	Mg	K	S-SO4	N-NO3	N-NH4
Sample Size	9	9	9	9	9	9
min-max	36.6-49.0	9.5-10.0	3.0-5.8	5.62-14.16	1.11-1.72	0.08-0.52
Average	45.1	9.9	4.8	10.60	1.39	0.32
%variation coefficient	8.4	2.2	18.9	33.55	14.21	66.33

Table 2. Na+ and F- concentration (mg/l), dissolved substances, pH and electrical conductivity (æ)

	Na	F	Dissolved substances	pH	Electrical conductivity
Sample Size	9	9	9	9	9
min-max	9.0-23.4	0.02-0.17	20.5-265.0	8.16-8.40	326.8-378.0
Average	1538	0.04	233.7	8.31	354.0
%Variation coeffiecient	29.7	126.9	10.5	0.78	4.5

Calcium and magnesium

Calcium and magnesium compounds are present in soil and water as products of weathering minerals. Calcium ions predominate in surface waters where the chemical composition is of geo-chemical origin. Calcium ions are quantitatively the most predominant substitute for individual nutrients in surface waters. Therefore, calcium is the most interchangeable component in surface water samples from the Danube.

Calcium concentration ranged from 36.6 to 49.0 mg Ca^{2+}/l, the average value was 45.1 mg Ca^{2+}/l and the variation coefficient was 8.4%. This concentration was 3 times greater in comparison to the average yearly concentration of calcium in the surface water of mountain streams in the Kremnicke vrchy region (14.42 mg Ca^{2+}/l). In open space precipitation, calcium concentration was 2.66 mg Ca^{2+}/l and in deciduous forest throughfall 3.66 mg Ca^{2+}/l.[2]

Magnesium concentration, in comparison to calcium and sodium concentration, was much lower. It ranged from 9.5 to 10.0 mg Mg^{2+}/l and the average value was 9.9 mg Mg^{2+}/l. In comparison to calcium and sodium the variation coefficient, 2.2%, was the lowest. In mountain streams the average year concentration of magnesium was 4.31 mg Mg^{2+}/l, in open space precipitation 0.45 mg Mg^{2+}/l and in throughfall 1.11 mg Mg^{2+}/l.

Potassium and sodium

From the alkaline elements measured, potassium concentration was the lowest, ranging from 3.0 to 5.8 mg K^+/l. Average concentration was 4.8 mg K^+/l and the variation coefficient was determined at 18.9%. In mountain streams the average yearly concentration of potassium was 3.50 mg K^+/l, in open space precipitation 1.66 mg K^+/l and in throughfall 11.19 mg K^+/l.

Sodium was the most abundant inorganic element present in surface water, after calcium. Its concentration ranged from 9.0 to 23.4 mg Na^+/l, the average value was 15.0 mg Na^+/l, and the variation coefficient 29.7%. In mountain streams the average yearly concentration of sodium was 4.79 mg Na^+/l, in open space precipitation 0.56 Na^+/l and in deciduous forest throughfall 0.58 mg Na^+/l.

Sulphur and sulphates

Input of atmospheric sulphur into terrestrial forest and aquatic ecosystems is, most frequently, in the form of sulphur dioxide (SO_2) and sulphuric acid (H_2SO_4), of both natural and anthropogenic origin. Both forms of sulphur are deposited in dry or wet deposition. Sulphur always accompanies acidic deposition. It plays an important role in the cycle of ecosystem elements and in their interaction with other elements.

Surface water sulphates have the highest concentration of ions. It ranges from 16.83 to 42.34 mg SO_4^{2+}/l and from 5.62 to 14.13 mg S-SO_4^{2-}/l, respectively. The variation coefficient (33.54%) reflects the great differences of sulphate concentration. The average yearly concentration of sulphates was relatively high in mountain streams, reaching 35.20 mg SO_4^{2-}/l. In open space precipitation, average yearly concentration was 17.26 mg SO_4^{2-}/l and 5.76 mg S-SO_4^{2-}/l, and, in throughfall, 20.24 mg SO_4^{2-}/l and 6.76 mg S-SO_4^{2-}/l.[3]

Nitrogen, nitrate and ammonium

Reactive species of nitrogen, such as NO_X, HNO_3, NO_3^-, NH_3, NH_4^+ and organically bonded nitrogen, are of natural and anthropogenic origin and they accompany acidic deposition. Their input is through dry and wet deposition into terrestrial and aquatic ecosystems. Nitrate ions are weakly adsorbed by the soil surface and easily leached. The opposite is true for sulphate ions, whose adsorption by the soil is an important factor for sulphur accumulation in ecosystems.

Nitrogen is indispensable for living organisms, but increased nitrate levels considerably deteriorate the quality of drinking water and endanger public health, particularly in the young population. High nitrate and ammonium concentrations indicate surface water contamination, especially as a consequence of increased fertiliser consumption. Nitrogen concentration in surface water is the lowest of all the elements measured.

The concentration of ammonium ions in the Danube water samples ranged from 0.10 to 0.67 mg NH_4^+/l, with an average value of 0.27 mg NH_4^+/l. The concentration of ammonium-nitrogen ranged from 0.08 to 0.52 mg N-NH_4^+/1, with an average value of 0.21 mg N-NH_4^+/1. The variation coefficient was relatively high - 66.33%. The average yearly concentration of ammonium ions in mountain streams is 0.38 mg NH_4^+/1, and that of ammonium-nitrogen 0.29 mg N-NH_4^+/1. Ion concentration in open space precipitation is 1.52 mg NH_4^+/1 and 1.18 mg N-NH_4^+/1, and in throughfall 2.11 mg NH_4^+/1 and 1.64 mg N-NH_4^+/1.

Fluorine

Many factors influence fluorine concentration, mainly geological bedrock erosion and the dissolution of minerals. Fluorine is emitted in the air, by various natural and anthropogenic sources, and it is subsequently found in precipitation and surface waters. Fluorine emissions are caused by the production of iron, steel and aluminum.[4,5]

Fluorine concentration was also determined in the samples. Except for one case - maximum value 0.17 mg F^-/1 - fluorine concentration was below the detection limit, with an average value of 0.04 mg F^-/1. Long-term monitoring is necessary in order to determine the yearly dynamics of fluorine concentration in surface water. Average surface water fluorine concentration in rivers and lakes has been estimated at 0.1

mg F-/1. Uncontaminated surface water usually does not contain more than 0.3 mg F-/1.

Acidity and alkalinity

pH values ranged from 8.16 to 8.40. The average pH value was determined at 8.31 and the variation coefficient at 0.78%. All pH values, according to the pH scale applied for soils, are in the zone of mild alkalinity - 7.2 to 8.5. The average yearly surface water pH value in mountain streams was approximately 7.5 - mildly alkaline. Open space precipitation had an average yearly pH value of 4.41, placing it in the very acidic zone. Prolonged contact with alkaline substrata can transform acidic precipitation to mildly alkaline.[6]

Dissolved substances and electrical conductivity

The concentration of dissolved substances in the samples ranged from 200.5 to 265.0 mg/1. The average value of 233.7 mg/1 agreed with the literature. The variation coefficient was 10.5%. The total concentration of dissolved substances in precipitation does not usually exceed 30 mg/1, however, in regions polluted by anthropogenic activity, it can exceed 100 mg/l.[1]

The electrical conductivity (æ) of surface water samples ranged from 326.8 to 387.0 ìS/cm, with an average value of 354.0 ìS/cm and a variation coefficient of 4.5%. Kalavska and Holoubek7 report values for Danube water electrical conductivity ranging from 326 to 556 ìS/cm.

These values were determined in solutions with greater ionic strength than that of precipitation. The average yearly value of the electrical conductivity of open space precipitation was 47.3 ìS/cm and that of mountain stream water 140.6 ìS/cm.

Conclusion

The Danube, south of Bratislava, creates a network of channels which have the characteristics of an inland delta. It is a very unique region from the point of view of nature conservation. The successive exploitation and management of the Danube, for economic purposes, led to the desertification of this region and to the endangerment of public health. Several projects and technical measures for flood simulations and the maintenance of stability in meadow ecosystems were proposed during the construction of the Gabcikovo waterworks.

The purpose of this research was to evaluate surface water quality in the region of the Gabcikovo waterworks and to determine flood water quality from the point of view of nutrient uptake. The research enabled to judge the influence of simulated floods on the nourishment of floodplain forests in the vicinity of the waterworks.

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