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Changes in water chemistry after flowing from the spring

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Abstract

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In this work we evaluate changes in chemical composition of water flowing out from its spring (I) and passing through a meadow ecosystem (II–VI). There are the quantitative changes in chemistry of water flowing from sampling sites (I) to (VI): potassium (68.5%), calcium (31%), magnesium (19%), sodium (16%), nitrogen (15%), electric conductivity (24%) and dissolved substances (5.2%) decrease. In opposite, sulphur (25.6%) and pH value (6.6%) increase. We study the influence of this water flow on the given ecosystem and compare the examined water with surface water in streams passing several other sites with similar geological substrate. Values of indicators in the studied samples confirm the nature of surface water. Calcium is the most abundant alkaline nutrient component (7.47 mg l^{-1}), followed by magnesium (3.63 mg l^{-1}) and potassium (1.92 mg l^{-1}). From airborne pollutants, there are present sulphates 31.46 mg l^{-1}, nitrates 10.07 mg l^{-1} and ammonium ions 0.03 mg l^{-1}. The pH value (water reaction) is 6.73, electric conductivity is 131.2 μS cm^{-1}. The amount of dissolved substances is 128.3 mg l^{-1}, from which 50.4% are inorganic and 49.6% are organic. The value of sodium concentration is 6.05 mg l^{-1}. All the indicators, with exception of nitrates ranking the water to the II-nd quality class (clear water), classify it to the first quality class (very clear water). No significant differences were found comparing the examined water with water in other surface streams in the Protected Landscape Area (PLA) Poľana Mts and in the Kremnické vrchy Mts. The changes in water chemistry indicate a favourable influence on the meadow ecosystem – its stability or also the soil cover.

Key words

surface water, changes in water chemistry, meadow ecosystem

Introduction

Chemistry of water flowing out from a spring and passing through a meadow ecosystem is subjected to changes. On the other hand, the water can influence the given ecosystem with dissolved substances (inorganic and organic) and with its chemical and physical properties (pH, electric conductivity). In the sampled water we indicated several acid and alkaline components entering the ecosystem as a result of human activities. Several components of water have an important role as biogenic elements, and their functioning in terms of physiology and biochemistry is key important and necessary for plant nutrition (Bublinec and Mihálik, 1996; Bublinec et al., 1996; Mihálik and Bublinec, 1997). Consequently, the primary importance at water analysis was put on determining nutrient elements and airborne pollutants. Surface waters contain, apart from hydrogen and oxygen, nine principal elements: Ca > C > Cl > Na > Mg > Si > S > K > N – ranked according to their weight concentration (Pačes, 1982). The content of sodium is also evaluated, because higher concentrations of this element can influence the soil and cause its salination, primarily in connection with deficit in calcium and magnesium.

Material and methods

The locality from which we sampled the water is situated southerly from the Protected Landscape Area (PLA) Poľana Mts, and also southerly from the Hriňová village. The material was sampled just at the beginning of growing season (March 1999) from six sampling sites – at the water spring and five other spots following the water flow at 50-meter intervals. The sampling sites together with the sampled material were labelled in the following way: (I) – spring, (II) – 50 m, (III) – 100 m, (IV) – 150 m, (V) – 200 m and (VI) – 250 m.

The water samples were subjected to physical-chemical and chemical analyses provided accorded to the methods used in the laboratories of the Institute of Forest Ecology of SAS in Zvolen. The pH values and nitrates are determined potentiometrically with an equipment pH/mV-meter and a measuring cell. The measuring cell is a pair of electrodes. The pH values are determined with a glass and a reference calomel electrode; the nitrates with a nitrate ion-selective electrode and a reference calomel electrode. Electric conductivity was determined conductometrically. The measuring equipment consists of a conductometer and a conductometric electrode. Photometric method was used for determination of ammonium ions. Sulphates were determined by titration on the indicator dithizon. Gravimetry (ČSN 83 0530 Standard) was used for obtaining amounts of dissolved substances; from these, the rest after ignition (inorganic portion of dissolved substances) and the loss of ignition (organic portion of dissolved substances) was calculated. Alkaline components were determined using the method of atomic absorption (calcium, magnesium) and atomic emission (sodium, potassium) spectrophotometry (Dubová, 1986, 1987, 1988, 1989, 1990a, b, c, 1992a, b).

The data obtained by physical-chemical and chemical analyses of the water (indicators) were processed statistically. The first information about the individual indicating values in the examined water samples was obtained based on the variation pattern (class, number, histogram) of the arranged data set. Another information was given by numerical characteristics: the characteristics of position (arithmetical mean, median, mode) characterising the average values, characteristics of variability (variance, standard deviation, variation range) expressing the degree of variability with respect to the mean value and the characteristics of skewness and kurtosis characterising the distribution shape, asymmetry (deviation) and concentration (Klein et al., 1999; Microsoft Excel, 2000; Šmelko, 1991).

Results and discussion

In the water sampled at the sampling sites (I)–(VI) we determined contents of nutrient elements (calcium, magnesium, potassium, sulphur and nitrogen) and airborne pollutants (sulphates, nitrates), the results are in Table 1. Other characteristic indicators of surface water quality are – pH value (water reaction), electric conductivity and contents of dissolved substances as well as sodium content (Table 2). Amounts of these indicators found in the studied samples confirm that the nature of the examined water is a surface one.

From alkaline elements was the most abundant calcium (7.47 mg l^{-1}), followed by sodium (6.05 mg l^{-1}), magnesium (3.63 mg l^{-1}) and potassium (1.92 mg l^{-1}). The amounts of sulphur and nitrogen are derived from concentration of sulphates (31.46 mg l^{-1}), nitrates (10.07 mg l^{-1}) and ammonium ions (0.03 mg l^{-1}). Sulphur (sulphate form) reaches higher values (10.5 mg l^{-1}) than nitrogen (2.3 mg l^{-1}), the value of which represents the sum of nitrate and ammonium form.

The mean pH value of water (water reaction) as the measure of its acidity or alkalinity reaches up to 6.73. According to the pH scale used for soil evaluation, this

Table 1. Basic statistical characteristics of nutrient elements and airborne pollutants in the sampled water (UN – unattainable)

Basic statistical characteristics	Ca^{2+}	Mg^{2+}	K^{+}	SO_4^{2-}	NO_3^{-}	NH_4^{+}
	(mg l^{-1})					
Arithmetical mean (AM)	7.47	3.63	1.92	31.46	10.07	0.03
Standard error	0.41	0.15	0.33	1.46	2.03	0.01
Median	7.82	3.76	2.18	32.70	9.84	0.02
Mode	UN	UN	UN	UN	UN	0.02
Standard deviation	1.01	0.36	0.81	3.57	4.98	0.02
Variance	1.02	0.13	0.66	12.72	24.83	0.00
Coefficient of kurtosis	–1.06	–1.91	–2.10	0.85	–1.77	1.43
Coefficient of skewness	–0.63	–0.71	–0.52	–1.23	0.25	1.54
Range	2.66	0.78	1.87	9.41	12.27	0.04
Minimum	6.00	3.18	0.86	25.28	4.68	0.02
Maximum	8.66	3.96	2.73	34.69	16.95	0.06
Number	6	6	6	6	6	6
Coefficient of variation (%)	13.5	9.9	42.2	11.3	49.5	66.7

value is within the neutral range 6.5–7.2. Electric conductivity – the measure of the total content of ions in water reaches a value of 131.2 μS cm^{-1} (13.12 mS m^{-1}). The content of dissolved substances is 128.3 mg l^{-1} and consists of inorganic (50.4%) and organic (49.6%) share. In general, the mean value of dissolved substances contens in surface water is about 120 mg l^{-1} (Pačes, 1982).

Most indicators of the examined water had negative values of kurtosis (K). This negative value ($K < 0$) means that many values were at the expense of extreme large and extreme small deviations. Negative values of kurtosis were found for ions of calcium, magnesium, potassium, nitrates, electric conductivity, dissolved substances and sodium ions. A positive value of kurtosis ($K > 0$) indicates lack of values having average deviations from the mean. Such a value was found for pH, ammonium ions and sulphates.

The values of coefficient of skewness (asymmetry) show that most indicators had most frequent negative values ($A < 0$), and then the result is a right asymmetry (the distribution is leaned to the right side). That means that most values are higher than the arithmetical mean (AM), their deviations from the mean are, however, smaller. This is true for ions of calcium, magnesium, potassium, sulphates, pH values, electric conductivity, dissolved substances and sodium ions. Coefficient of skewness is only positive ($A > 0$) for nitrates and ammonium ions, in this case, the asymmetry is left one (the distribution is leaned to the left side). That means that most values are smaller than the AM, however, with smaller deviations from the AM, the values on the other side of the distribution are less numerous but they have bigger deviations.

For two nutrients (nitrogen, potassium) we found high variability of the values. The highest value of variation coefficient was found for nitrogen (ammonium 66.7%, nitrate 49.5%). The variability of this element was influenced by low nitrogen concentration (both forms) in the examined water. The low concentration could be the result of higher demands on nitrogen for the ecosystem in spring. The increased variability of potassium values (42%) confirms high mobility of this element in water solutions. Its mobility is conditioned by good solubility of potassium salts in water and easy washout of potassium from plant organisms (Nováček, 1986; Pačes, 1982). Variation coefficients of other indicators were lower, ranging from 3.6% to 13.5%. From all the indicators, the lowest variation coefficient (3.6%) was found for pH (water reaction), which means that the corresponding data set is the most equalised.

We also evaluated quantitative changes in values of the individual indicators of water quality after flowing from the spring (sampling site I). With increasing distance from the spring, the examined water showed decreasing electric conductivity, content of dissolved substances, concentration of nitrates and alkaline elements (calcium, magnesium, potassium, sodium). On the other hand, there were moderately increasing pH values. There were also increased concentration of

Table 2. Basic statistical characteristics of pH values and electric conductivity values, contents of dissolved substances and sodium in the sampled water (UN – unattainable)

Basic statistical characteristics	pH	Electric conductivity (μS cm^{-1})	Dissolved substances (mg l^{-1})	Na^+ (mg l^{-1})
Arithmetical mean (AM)	6.73	131.2	128.3	6.05
Standard error	0.10	5.2	6.0	0.22
Median	6.79	135.5	129.0	6.25
Mode	uN	137.6	uN	6.51
Standard deviation	0.24	12.7	14.7	0.53
Variance	0.06	160.9	216.7	0.29
Coefficient of kurtosis (K)	3.81	–0.6	–2.6	–2.12
Coefficient of skewness (A)	–1.78	–0.7	–0.1	–0.59
Range	0.68	34.4	34.0	1.16
Minimum	6.28	111.8	110.0	5.35
Maximum	6.96	146.2	144.0	6.51
Number	6	6	6	6
Coefficient of variation (%)	3.6	9.7	11.5	8.8

sulphates and ammonium ions. The values obtained in the examined water stream were finally compared with the data obtained for surface water streams in the PLA Poľana Mts (Bobrovo, Hučava, Šafranička and Veľká voda) and in the Kremnické vrchy Mts (Kováčovský potok). The mean indicator values are summarised in Tables 3 and 4. Dissolved substances for these two streams were not determined.

Calcium

From the alkaline elements, calcium has the highest concentration in the examined water. The mean concentration is 7.47 mg l^{-1}. Variation coefficient of calcium concentration is 13.5% (Table 1). The values of concentration decrease from maximum (8.66 mg l^{-1}) in the spring (I) up to minimum (6.0 mg l^{-1}) in site (VI). This decrease makes 31%, or 2.66 mg l^{-1} (Fig. 1), which is also the value of variation range. The trend is linear, and it can be expressed by equation $y = a + bx$, with $a = 9.1747$, $b = -0.4866$. Correlation coefficient (r) is 0.9003. The decrease in concentration from (I) to (IV) is 0.61 mg l^{-1}, from (IV) to (VI) it is 2.05 mg l^{-1}. Mean concentration (7.47 mg l^{-1}) in the examined water (Table 3) is most similar to the value obtained for the water stream Bobrovo in the PLA Poľana Mts (7.68 mg l^{-1}). Comparing the examined water with surface water in a mountain stream (Kováčovský potok) in the Kremnické

Table 3. Comparison of nutrient elements contents (arithmetical means) between the examined surface water-flow and water of some other streams

Locality	Ca^{2+}	Mg^{2+}	K^{+}	SO_4^{2-}	NO_3^{-}	NH_4^{+}
	mg l^{-1}					
Examined flow of water	7.47	3.63	1.92	31.46	10.07	0.03
LPA Poľana Mts Bobrovo, stream	7.68	3.59	0.87	31.67	1.32	0.17
LPA Poľana Mts Hučava, stream	8.65	3.80	0.85	23.54	6.19	0.07
LPA Poľana Mts Šafranička, stream	5.58	3.35	0.64	27.36	3.09	0.12
LPA Poľana Mts Veľká voda, stream	5.50	3.11	1.08	25.05	2.61	0.09
Kremnické vrchy Mts Kováčovský potok, stream	14.43	6.48	1.76	36.30	4.48	0.22

Table 4. Comparison of the values of pH, electric conductivity and concentration of sodium (arithmetical means) between the examined surface water-flow and water of some other streams

Locality	pH	Electric conductivity (µS cm^{-1})	Na^{+} (mg l^{-1})
Examined flow of water	6.73	131.2	6.05
LPA Poľana Mts Bobrovo, stream	7.74	135.6	6.14
LPA Poľana Mts Hučava, stream	7.53	113.1	3.74
LPA Poľana Mts Šafranička, stream	7.41	103.3	3.63
LPA Poľana Mts Veľká voda, stream	7.68	112.7	4.43
Kremnické vrchy Mts Kováčovský potok, stream	7.28	165.7	4.08

vrchy Mts (14.4 mg l^{-1}), our values were almost two times lower (Bublinec and Dubová, 1993a).

Magnesium

The mean concentration of this element (3.63 mg l^{-1}) in the examined samples was about a half of that of calcium. The value of variation coefficient is 9.9% (Table 1). The concentration of magnesium decreased from 3.96 in site (I) to 3.18 mg l^{-1} in site (VI). This 19% decrease can also be fitted with a linear equation (a = 4.1460; b = –0.1474). The value of correlation coefficient is 0.7747 (Fig. 1). The mean concentration of magnesium in the examined water (3.63 mg l^{-1}) is the most similar to the value (3.59 mg l^{-1}) obtained for the stream Bobrovo (Table 3). As in case of calcium, the mean concentration of magnesium in the examined water samples is almost two times lower than in the stream Kováčovský potok with a value of 6.48 mg l^{-1}.

Potassium

From alkaline elements, potassium had the lowest content in the examined water (Table 1). The mean concentration of potassium is 1.92 mg l^{-1} and the value of variation coefficient is 42.2% (Table 1). Its concentration decreased from site (I) to (VI), from a value of 2.73 to 0.86 mg l^{-1} (Fig. 1). This decrease is the steepest (68.5%) from the discussed alkaline elements, and it is also linear (a = 3.3753, b = –0.4163). The value of correlation coefficient is 0.9565. The mean concentration of potassium in the examined water (1.92 mg l^{-1}) is most similar to the value obtained for the stream Kováčovský potok (1.76 mg l^{-1}) and 2- to 3-times higher than in surface water streams in area of the PLA Poľana Mts (Table 3).

Sodium

The concentration of sodium in the examined water samples follows immediately after calcium. The mean sodium concentration is 6.05 mg l^{-1}. The variation coefficient of sodium concentration has the second lowest value (8.8%) – subsequent to pH (3.6%), from all the studied indicators (Table 2). It also decreases from site (I) to (VI), with the values of 6.51 to 5.46 mg l^{-1}. Compared to the other alkaline elements (Fig. 1), the decrease of sodium concentration is the lowest (16%). The change is linear (a = 6.8633, b = –0.2314). The value of correlation coefficient is 0.8097. The mean sodium concentration (Table 4) in the examined water (6.05 mg l^{-1}) is the closest to the value found for the stream Bobrovo (6.14 mg l^{-1}). It is higher than the value for Kováčovský potok (4.08 mg l^{-1}) and other streams in the PLA Poľana Mts (3.63 to 4.43 mg l^{-1}).

Sulphates (Sulphur)

The mean value of concentration of sulphates in the examined water is 31.46 mg l^{-1}. The variation coefficient is 11.3% (Table 1). The concentration of sulphates increases from site (I) to (II), from a value of 25.28 to 34.69 mg l^{-1}. This change (9.41 mg l^{-1}) represents the whole variation range. The initial increase was followed by a

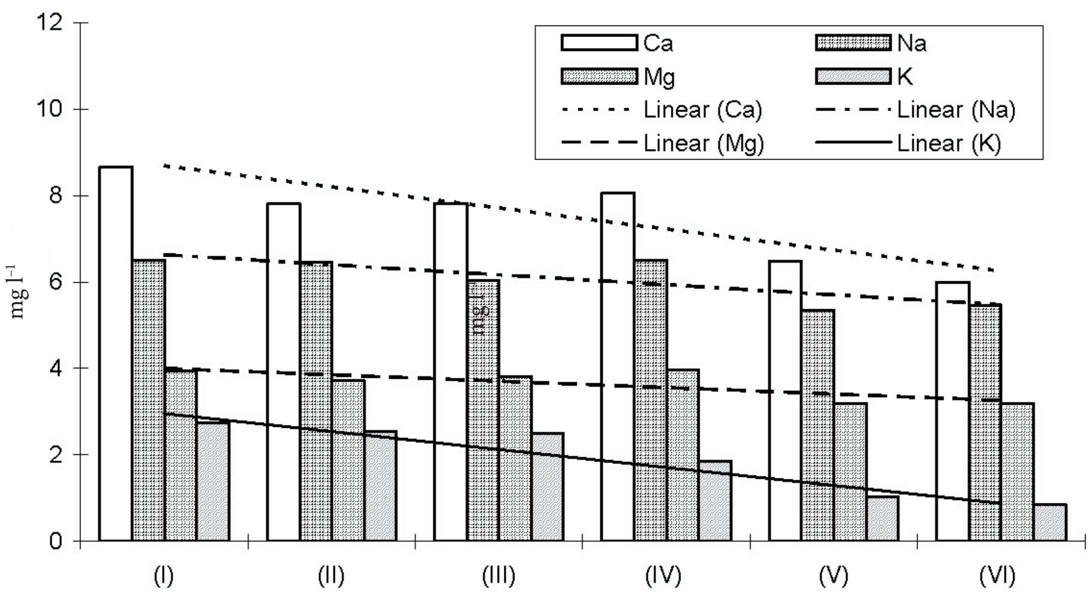

Fig. 1 Changes in contents of alkaline elements, following the water flow from sampling site (I) to (VI)

decrease to 29.39 mg l^{-1} at (IV) and another moderate increase to 34.00 mg l^{-1} in site (VI). These changes (Fig. 2) can be well fitted with a 3-rd degree-polynomial for which the correlation index (r) is 0.9251. However, the sulphate concentration is still evident increasing when the trend is fitted with a linear function (a = 9.4600, b = 0.2971). The value of correlation coefficient is 0.4671. The sulphates concentration values in Fig. 2 are expressed in form of sulphate sulphur (S), for comparison with nitrogen obtained from both its forms. The mean value of concentration of sulphates (Table 3) in the examined water (31.46 mg l^{-1}) is the most similar to the value determined for the stream Bobrovo (31.67 mg l^{-1}). In terms of sulphates content (<80 mg l^{-1}), the examined water can be ranked to the first quality class (very clean water), according to the classification used for assessment of surface water quality (STN 75 2221 Standard).

Nitrates and ammonium ions (Nitrogen)

The concentration of nitrates is very variable. From site (I) to (VI) it was lowered by 2.15 mg l^{-1}. The mean concentration is 10.07 mg l^{-1}. Concentration of ammonium ions is also very variable and low. The minimum value (0.02 mg l^{-1}) is about the threshold of discernibility. The mean concentration is 0.03 mg l^{-1}. The two indicators have high values of variation coefficient (Table 1): 49.5% (nitrates) and 66.7% (ammonium ions). The variation range for nitrates is 4.68–16.95 mg l^{-1}, with the maximum value in sampling site (III). The variation range for ammonium ions is 0.02–0.06 mg l^{-1}, with the maximum value in (IV). The nitrogen content (sum on the two forms) decreases from (I) to (VI) (Fig. 2). The mean concentration of nitrates in the examined waters (10.07 mg l^{-1}) is two or more times higher than the values determined for streams in the PLA Poľana Mts and for the stream Kováčovský potok (Table 3). However, the values of nitrates concentration are not as high as to have an adverse influence on the examined ecosystem. As for the nitrates content (<15 mg l^{-1}), the examined water can be classified as belonging to the second quality class (clean water) according to the surface water assessment (STN 75 2221).

Water reaction (pH)

The mean pH value in the examined water is 6.73. Variation coefficient has the lowest value (3.6%) from all the studied indicators (Table 2). The pH value of water (6.28) in the sampling site (I) is in the moderately acid range (5.5–6.5). Then the value pH moderately increases (Fig. 3) through the site (II) to (III) up to the neutral range (6.5–7.2). The value in site (III) is 6.96, ie by 0.68 lower than in site (I). Then it follows a slight decrease to 6.72 in site (VI). The pH value, despite decrease, maintains in the neutral range. The pH increase over the whole pathway from (I) to (VI) was 0.44. At the linear trend (a = 6.5353, b = 0.0566) the coefficient of correlation is 0.4470. The change in water reaction (pH) can be better fitted with a polynomial of the 3-rd degree. The value of correlation index is 0.9985. The mean pH value (6.73) classifies the water to the neutral range, although pH values of all the compared streams

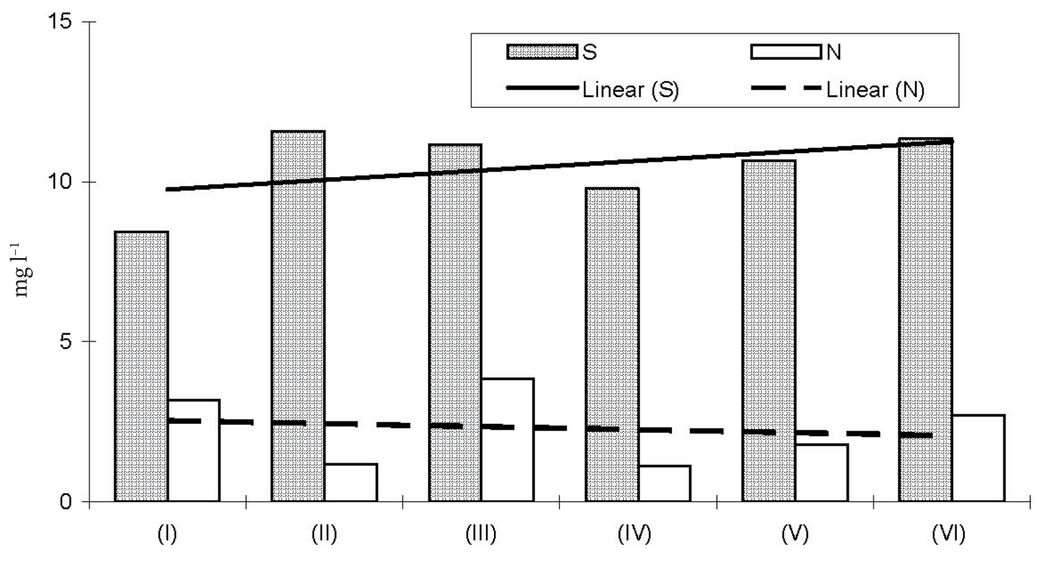

Fig. 2. Changes in contents of sulphur and nitrogen, following the water flow from sampling site (I) to (VI)

are situated in moderate alkaline range (7.2–8.5). The pH value of our examined water is lower almost by 0.55–1.01 pH unit – compared to the other referred streams (Table 4). The pH of our water is the most similar to the pH value (7.28) for the stream Kremnický potok (Dubová, 2001).

Electric conductivity

The mean value of electric conductivity is 131.2 µS cm^{-1}. The coefficient of variation is 9.7% (Table 2). The electric conductivity (EC) moderately decreases from site (I) to (VI) (Fig. 4). This decrease (24%) can be considered as linear (a = 153.94, b = –6.5114, r = 0.9605) and it represents 34.4 µS cm^{-1}. From the maximum value 146.2 µS cm^{-1} in site (I), decreases electric conductivity to a minimum of 111.8 µS cm^{-1} in site (VI). The decrease over the first segment from (I) to (III) is more moderate (12.9 µS cm^{-1}) than over the second one from (III) to (VI) (21.5 µS cm^{-1}). The mean value of electric conductivity of the examined water flow (131.2 µS cm^{-1}) is within the range of the values of all the examined watercourses (Table 4). The most similar value was found for the stream Bobrovo (135.6 µS cm^{-1}).

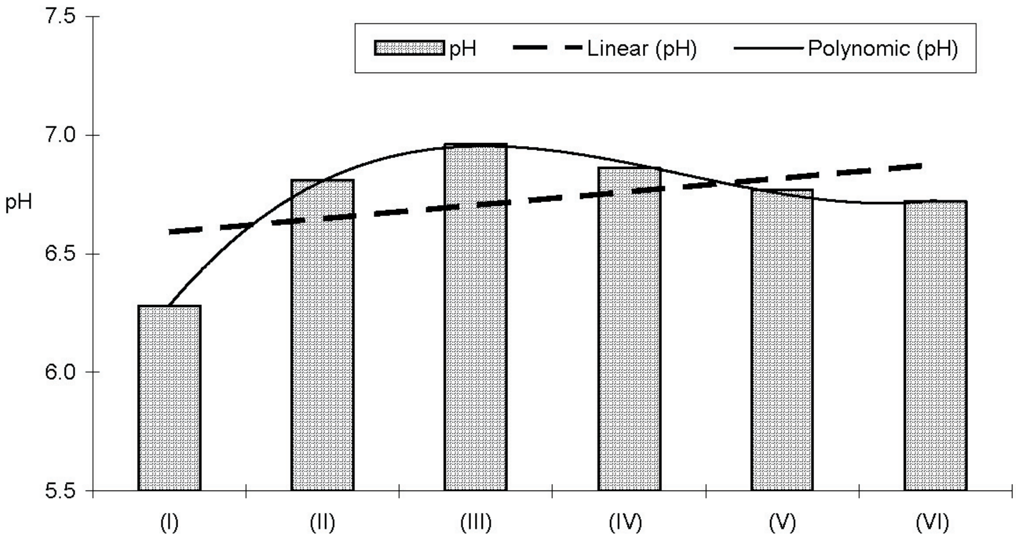

Fig. 3. Changes in pH-values, following the water flow from sampling site (I) to (VI)

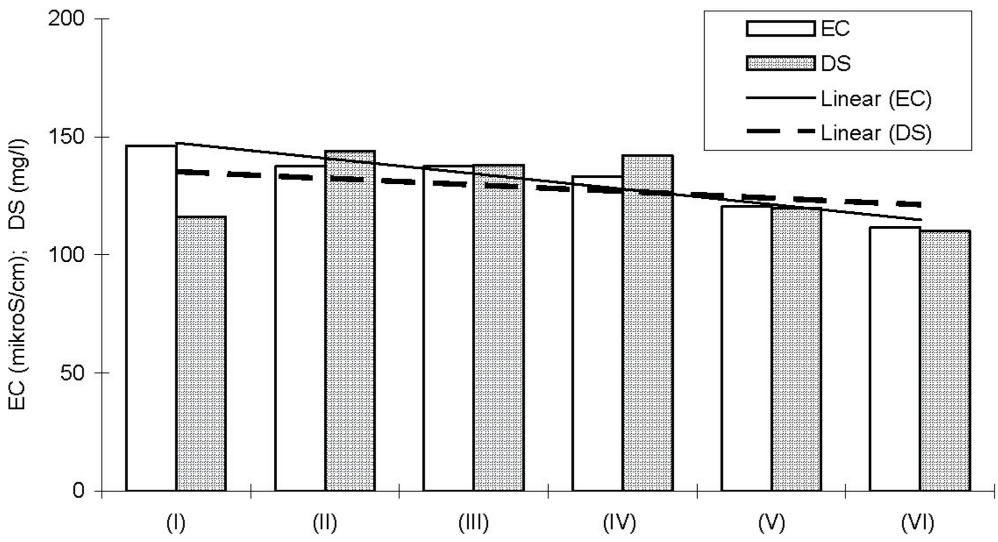

Fig. 4. Changes in electric conductivity (EC) and contents of dissolved substances (DS), following the water flow from sampling site (I) to (VI)

Dissolved substances

The mean value of the dissolved substances (DS) content is 128.3 mg l^{-1}, the coefficient of variation is 11.5% (Table 2). The content of dissolved substances only showed a little decrease from site (I) to (VI); from a value of 116 to 110 mg l^{-1}. In spite of the fact that the value of this parameter was found higher in sites (II)–(IV) reaching above 140 mg l^{-1}, after 250-meters of water flow, at site (VI), the dissolved substances reached almost their initial value (I). After fitting with a linear function (a = 138.13, b = –2.80), we have obtained the correlation coefficient of 0.3558 (Fig. 4). More appropriate fitting is possible with a 3-rd degree polynomial. In this case, the correlation index is 0.9549.

Dissolved substances represent the total of inorganic and organic substances dissolved in water. After the first 50 m along the water flow, from (I) to (II), the content of inorganic substances was lowered (31%), and the content of organic substances was increased by more than two times. We suggest that this conspicuous change in (II) was the result of impact of the meadow ecosystem contacting the water after its flow from the spring. From site (II) up to (VI), the content of inorganic substances increases, the content of organic substances decreases. The total change in inorganic substances from (I) to (VI) is a very small (2 mg l^{-1}) increase. For fitting with the linear trend (a = 56.667, b = 2.2857), the correlation coefficient is 0.4658. On the other hand, the change of inorganic substances content from (I) to (VI) was somewhat lowered (8 mg l^{-1}). At the linear trend (a = 81.467, b = –5.0857) the correlation coefficient is 0.4145.

Conclusions

The aim of this work was to evaluate the changes in chemistry of a water flow crossing a meadow ecosystem, and to assess its influence on the ecosystem. The amounts and trends in nutrient elements (calcium, magnesium, potassium, sulphur and nitrogen), the most important airborne pollutants (sulphates, nitrates, ammonium ions) as well as sodium content suggest about their favourable influence of the meadow ecosystem. There are the quantitative changes in chemistry of water flowing from sampling sites (I) to (VI). Potassium (68.5%), calcium (31%), magnesium (19%), sodium (16%), nitrogen (15%), electric conductivity (24%) and dissolved substances (5.2%) decrease. In opposite, sulphur (25.6%) and pH value (6.6%) increase. Quantitative values of these indicators in the examined samples confirm the nature of surface water. Calcium (7.47 mg l^{-1}) is the most abundant alkaline nutrient, followed by magnesium and potassium (3.63 mg l^{-1} and 1.92 mg l^{-1}, respectively). Concentrations of the most important airborne pollutants are: 31.46 mg l^{-1} sulphates (10.5 mg l^{-1} sulphate sulphur), 10.07 mg l^{-1} nitrates (nitrate nitrogen 2.28 mg l^{-1}) and 0.03 mg l^{-1} ammonium ions (ammonium nitrogen 0.02 mg l^{-1}). The pH value (6.73) is, according to the scale used for soils, in the neutral range. Electric conductivity is 131.2 μS cm^{-1}. The amount of dissolved substances is 128.3 mg l^{-1}, from which 50.4% (64.7 mg l^{-1}) are inorganic and 49.6% (63.7 mg l^{-1}) are organic. Sodium concentration is 6.05 mg l^{-1}. All these values rank the examined water in the first quality class (very clean water), apart from nitrates, ranking it to the second quality class (clean water).

Comparing the examined water with water of several surface streams in the PLA Poľana Mts (Bobrovo, Hučava, Šafranička, Veľká voda) and in the Kremnické vrchy Mts (Kováčovský potok), there are no significant differences. From the obtained results we can see that our values of calcium, magnesium, potassium, sulphates, ammonium ions, electric conductivity and sodium are comparable to the values in the above listed streams. Only the concentration of nitrates is 1.6- to 7.6-times higher. As we have already stated, it is not such high as to have an adverse influence on the examined ecosystem, its stability or, eventually, soil cover. The mean pH value in the examined water (neutral range 6.5–7.2) is lower than were the pH values found for all the compared streams (moderately alkaline, pH 7.2–8.5). The difference between them is 0.6–1.0 pH. The values and changes found in the chemistry of the water flow suggest about its favourable influence on the relevant meadow ecosystem.

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Zmeny v chemizme vody po odtoku z prameňa

Súhrn

V práci hodnotíme zmeny v chemizme vody, ktorá vyteká z prameňa (I) a steká povrchom lúčneho ekosystému (II) až (VI), ako tok vody ovplyvňuje daný ekosystém a vodu porovnávame s povrchovými tokmi na stanovištiach s porovnateľným geologickým podložím. Chemizmus vody sa kvantitatívne mení, pričom klesá draslík (68,5 %), vápnik (31 %), horčík (19 %), sodík (16 %) ako aj dusík (15 %), elektrická vodivosť (24 %) a rozpustené látky (5,2 %). Naopak, zvyšuje sa obsah síry (25,6 %) a hodnota pH (6,6 %). Kvantitatívne hodnoty ukazovateľov v skúmanej vode potvrdzujú charakter povrchovej vody. Alkalické zložky dosahujú 7,47 (Ca^{2+}), 3,63 (Mg^{2+}), 1,92 (K^{+}) a 6,05 (Na^{+}) mg l^{-1}, imisné zložky 31,46 (SO_4^{2-}), 10,07 (NO_3^{-}) a 0,03 (NH_4^{+}) mg l^{-1}. Hodnota pH je 6,73 a elektrická vodivosť 131,2 S cm^{-1}. Rozpustených látok je 128,3 mg l^{-1}, z čoho 50,4 % je podiel anorganických a 49,6 % organických látok. Všetky ukazovatele zaraďujú skúmanú vodu do I. triedy čistoty (veľmi čistá voda), okrem dusičnanov, ktoré sú v II. triede čistoty (čistá voda). Skúmaná voda sa od porovnávaných povrchových tokov v Chránenej krajinnej oblasti Poľana a v Kremnických vrchoch výrazne neodlišuje. Zmeny v chemizme vody hovoria o priaznivom vplyve pretekajúcej vody na lúčny ekosystém, jeho stabilitu, prípadne pôdny pokryv.