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WATER SUPPLY AND VEGETATION SYSTEM OF STREAM CIBULKA

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Introduction

The Stream Cibulka located in front of the Velencei Mountains (**Fig. 1.**) was probably not a „significant" water course either at the time of its first military depiction (in the second part of the 1700s). The spontaneous nature of the vegetation of the small water course surrounded by fields already at that time, distinguishes the stream from the surrounding areas. Thus, although the water course does not have any special natural qualities, it poses several interesting questions which can be considered to be "up-to-date".

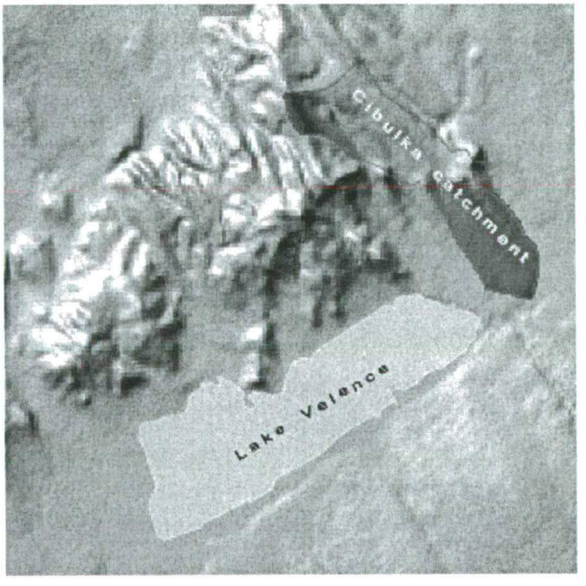


Figure 1. River basin and the surroundings of the Stream Cibulka

The Stream Cibulka is a temporary water course. Its river bed is basically man-made in its overall length, it has a straight run-off and a regular cross-section (obtrapeziform) (**Fig. 2.**). The wetland, which undoubtedly used to surround the stream, has now almost completely disappeared. The same thing happened to the "services" provided by this wetland free of price. Recognizing this problem, there have been more and more efforts aiming at revitalisation-rehabilitation activities (NAGY, 2001; UDVARDI, 2001).

Approaching the subject from this perspective, we ask questions regarding particularly the environmental science, since our aim is to influence our own habitat and to establish more favourable conditions for ourselves.

Ecology has a different approach towards the same subject. Its main area of interest is the question, which species does this small regulated water course (water channel at the site, we would perhaps prefer using the expression water cannel instead), which has been surrounded by fields for centuries and which has a river basin that has been intensively cultivated until today, serve as a habitat. Furthermore, to what extent is the vegetation system in accord with the soil qualities, among them the parameter of water supply.

A potential question from the point of view of Geography (which induces a similar analysis) is the following: where and what sort of wetland does the relief of the river basin and its soil qualities predestinate?

Figure 2. Man-made bed fragments of the Stream Cibulka (taken in April).
Photo by Károly Barta

We have planned our analysis on the basis of the following approach:

1. Relying on the coenological samples and the relative ecological figures (relative groundwater and humidity index (WB)) we examine this kind of differentiation emerging in this vegetation.
2. We record some environment parameters that determine water supply.
3. We compare the results obtained.

To put it briefly, - out of the several questions arising in connection with the topic – we aim at answering the following: What kind of relation is there between some environmental parameters determining water supply and the differentiation in the vegetation?

The Stream Cibula was last regulated in 1982-83, when its overall length was regulated uniformly. The documentation called "Plan on the Recultivation of the Stream Cibulka" [„Cibulka-víz jókarbahelyezési terve"] gives an adequate picture of the work and the current state.

This documentation also contains the only evidence questioning the spontaneous character of the vegetation. It mentions a possible planting of *Baldingera arundinacea* on the lower section of the stream in order to secure the riverside of the newly made bed.

The relative ecological value figures (BORHIDI, 1993) include the likelihood rate of occurrence of the different plant species summed up in relation to the given parameters on the basis of the landscape approach. When we depart from the "prize-chosen" approach, it might result in the wrong interpretation. This also applies to the vegetation criteria that are in accordance with the habitat factors. In connection with the application of these indexes, conditions have a particularly important role (BARTHA, 2002).

Material and methods

We determined a 4.4 km long section of the Stream Cibulka from its spring to the highway M7 to be the examination site. The remaining section of the stream to the water course Vereb-Pázmándi (the estuary is on the territory of Kápolnásnyék) is 2 km long and flows mainly through an inhabited area (there are some places where the river bed is concrete-covered and enclosed), that is why this area we left out of the examination. On the stream segment examined sheep is grazed at irregular intervals; at some places the bed is deepened so that the sheep can drink.

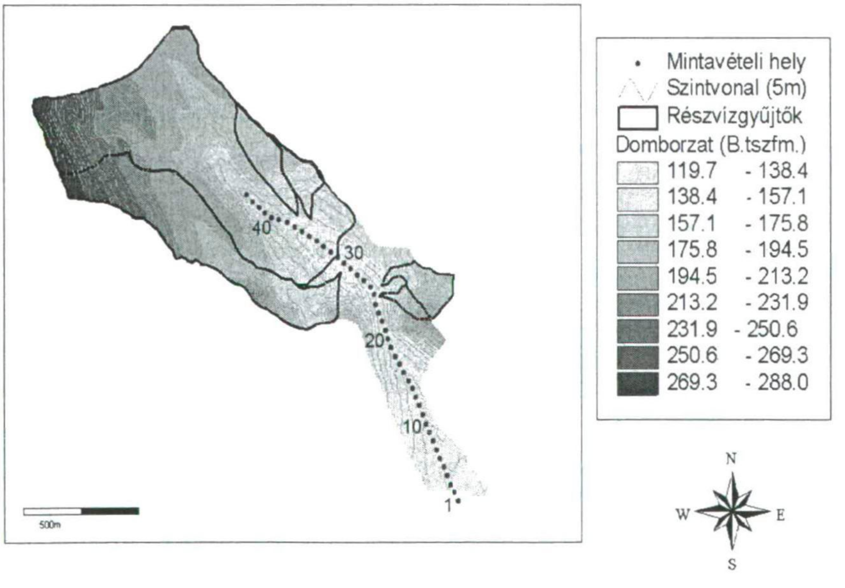


Figure 3. Sampling sites on the river basin and the bed-bottom belonging to the stream section examined

The sampling sites were determined at every 100 meter along the stream. The starting point was determined at random. The numbering of the 44 sampling sites (point 1) starts with the endpoint of the examined section opposite the spring. Thus the spring (the highest point of the man-made bed) is the sampling point 44 (**Fig. 3.**). The vegetation at the bottom of the obtrapeziform bed was characterized by taking coenological samples.

The middle point of the 0.6×1.5 metre sized squares followed each other in every 100 metre. The length side was parallel with the bank sole, the width side was adjusted to the squares located on the narrowest bed segment.

According to the data of the technical plans the width was 0.6 metre (ranging between 0.6 and 1.5 metres). The length of the squares of 5 metres resulted from the consideration of two factors.

Supposing a continuous change or transition in connection with the water supply along the stream, it was appropriate to determine the length of the square to be as short as possible. The other factor considered was to calculate the minimal dimension on the basis of the experience based on the classic coenological data. The coenological samples were collected in the last week of May 2004. We estimated a proportional coverage species by species and an overall coverage. The names of the species and the relative ecological figures (WB) correspond to the ones in the work by Borhidi (BORHIDI, 1993).

At every sampling point a hole was bored into the lower third of the bank slope with a hand drill until reaching the groundwater, then it was plugged with a long-shaped plastic bowl. From April (when the wells were deepened) until August the depth of the groundwater-plane was read at the beginning of each month (between the 6th and 10th). At places where we could not reach the bed bottom after boring 1.5 metres below the groundwater-plane, we stopped boring.

Measuring the height between the bed bottom and the well ledge the distance between the groundwater-plane and the bed bottom could be calculated from the data on the groundwater depth. When the groundwater-plane was measured monthly, it was also recorded whether the bed bottom was dry (bed has dried up) or wet (there was water in the bed).

The data obtained this way make it possible to make a distinction between the influent and effluent segments at every sampling time, so it can be stated that if the groundwater of the areas located on both sides of the bed supply (effluent) or rather drain (iffluent) the water out of the bed.

The soil samples were collected in June 2004. An undisturbed soil sample (0-5 cm) and a surface soil sample weighing approx. 1 kg (0-10 cm) were taken from the middle of the squares of the coenological samples at each sampling point. Following a general sample preparation, the Arany-type soil cohesion index and the vegetable matter content was determined (Tyurin method (BUZÁS, 1988)).

The digital relief model of the river basin and the borders of sub-basins were identified with the program EROSION 3D.

Results

Assessing the data of the groundwater wells

We have summarized the results in **Fig. 4.** The 0 point on the value axis and the horizontal line cutting this point stand for the bed bottom. The positive values (above the horizontal line) indicate that at those points it was the groundwater (spring) that supplied the stream with water.

In these cases some water can be found in the bed (which may also partially result from surface onflow). As for the negative values, the groundwater-plane did not come to the surface in the bed sections belonging to the given sampling point. In the present case the bed can both be dry and wet (should there be some surface onflows).

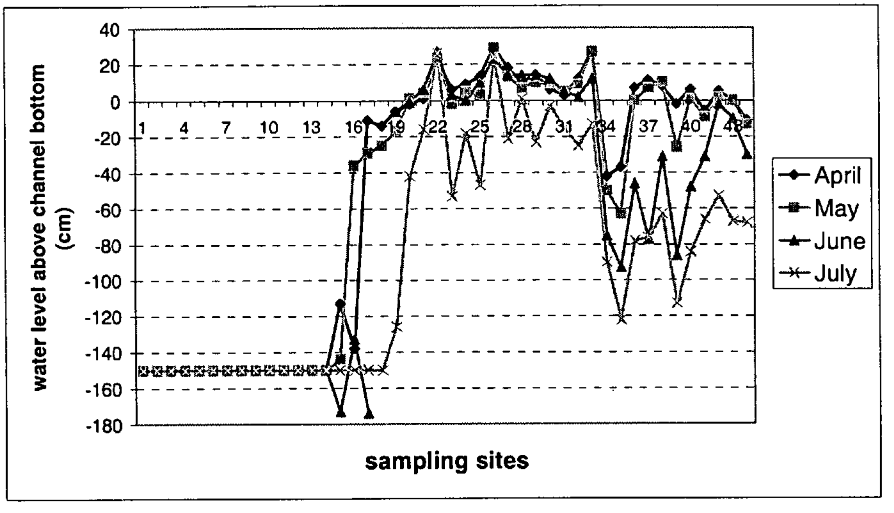


Figure 4. Location of the groundwater compared to the bed bottom

The first 14 sampling sites are uniform regarding the fact that the groundwater was found deeper than 1.5 metres at the time of all the four sample collections. Supposing that the groundwater-plane located deeper than 1.5 metres cannot be the water spring for herbs living in the bed, its depth was not relevant for the examination. The points on this segment of the stream are differentiated on the basis of the data obtained from the groundwater wells. At the remaining 30 points of the examined section in 94% of the cases the groundwater was found in a depth of max. 1.5 metres. In the following this segment is the focus of our examination. In general, it can be stated that the groundwater at all sampling sites decreased at the sampling collection times. The inaccuracy of the measurement was within 5 cm. The water level risings occurring occasionally were within the inaccuracy limits, thus it cannot be claimed whether the water level rising was real. From the point of view of the data obtained at four times and that of the aim of the examination, it is not significant. The pace of the decreasing varies at different sections of the stream. On the basis of this, the 1.2 km long segment located between the points 20 and 32 differs significantly.

A common feature of these points is that on the basis of the data obtained from the first three measurements (April, May, June) the groundwater did not exceed the decrease of 10 centimetres. Considering the data from July this segment is no longer uniform, as at some points the extent of the decrease of the groundwater exceeded even 40-50 centimetres (sampling sites 20, 23, 25); at other points the alteration was within the inaccuracy limits. Comparing the data indicating whether the bed is wet or dry (**Fig. 5.**) and the diagram it we can state that the stream had only four springs at the beginning of July.

There are six sampling sites where the bed contains water, however, there are only four of them where the groundwater comes to the surface (points 22, 26, 28, 30). At the point 30 the groundwater level is found to be 3 cm below the bed bottom, but at the same time, there was water in the bed. The alteration within the inaccuracy limits of 5 cm mainly resulting from the inequality of the bed bottom is of no importance for us; this point is also to be considered to be spring. The springs at the points 26, 28, and 30 cannot provide surface water at the sampling sites located 100 m further down along the stream. The spring at point 22 provides surface water along a section stretching at least 200 metres. Comparing the two figures it can also be stated that going downwards from point 19 to the end of the examined segment the water in the bed comes from the upper segment in each case, as there are no places where groundwater would come to the surface. Consequently, the 1.8 km long segment between the sampling point 1 and 19 can be considered uniformly influent during the examination period.

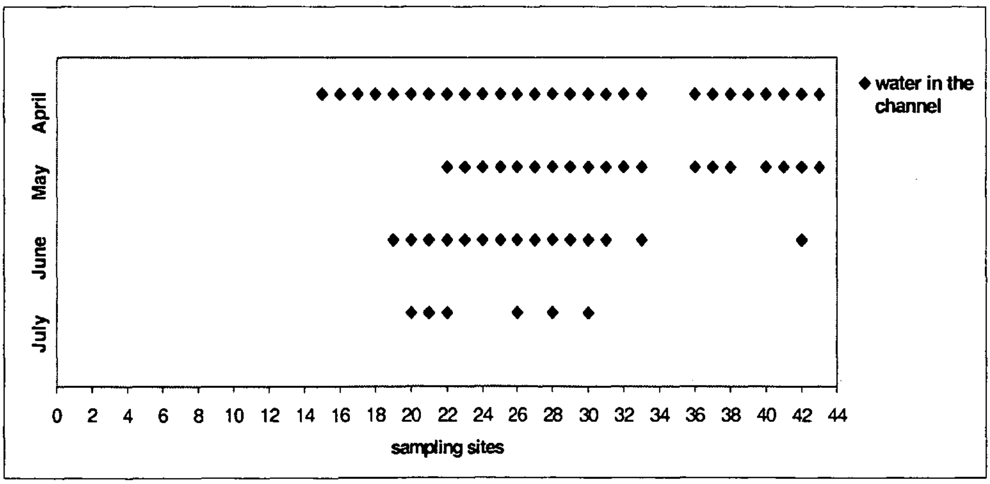


Figure 5. Surface water occurring in the stream bed at different times

The segment bordered by the sampling sites 33 and 44 is characterized by the fact that in comparison with the values from April and May, the decrease in June and July was more significant. On this segment there were only two places where there was water in the bed at the time of the recording in June, and the whole segment turned out to be completely dry at the time of the recording carried out in July.

Results of the pedological analysis

The lowest Arany-type cohesion index fell under the category sandy loam soil, while the highest index fell under the category heavy clay soil (STEFANOVITS, 1999). There is no unambiguous trend alongside the stream. The same may be said in connection with the results concerning the vegetable matter content, as well. The two parameters are in close relation with each other on the basis of the run of the curves. The proposed pedological examinations include determining the distribution of individual particles as well as the cubic mass of the undisturbed samples.

General characterization of the vegetation of the stream bed

The vegetation of the regulated bed cannot be satisfactorily described by listing the communities occurring. The fact that species having different coenological preferences and habitat needs occur "mixed", located near each other is probably the result of the small transversal dimension and of the few species available as well as of the man-made bed shape. Consequently, there are only few points where the characteristic physiognomic picture of some combinations can be observed. The types that still occur and can be unambiguously identified, outline a coenologically "idealized" picture. Based on the National Habitat Classification System (FEKETE ET AL., 1997; BÖLÖNI ET AL., 2003), which is rooted in coenology, after field studies made on several occasions the following picture can be outlined:

The vegetation on the segments where there is water in the bed during the summer for a long time (July-August) is *Glyceria, Sparganum and Schoenoplectus beds* (B2). The most typical species of this kind of vegetation are the following: *Glyceria plicata, Sium erectum, Catabrosa aquatica.* Typically, this zone is accompanied by a string of tall herb communities (*Water-fringing and fen tall herb communities* D5). Characteristic species: *Angelica sylvestris, Mentha longifolia, Epilobium hirsutum. Caricetum acutiformis-riparial* can be seen at some places (*Non-tussock beds for large sedges* B5). Typical species: *Carex acutiformis.* There are some places in the bed that are covered with sedge-marshes (*Eu- and mesotrophic reed and Typha beds* B1a). *Phragmites communis* és *Calystegia sepium* are the most common species.

These habitats often mix with each other, or with uncharacteristic treeless communities (*Uncharacteristic meadows and tall herb communities OB, Uncharacteristic wetlands OA*) forming a "network" difficult to be segmented.

Evaluation based on the coenological samples and the recordings concerning water supply

According to the mean WBs calculated from the group-proportion of the coenological examinations (**Fig. 6.**) it can be seen that there is a declining tendency from sampling point 22 to the lower end (point 1) of the segment analysed. Relying on the evidence represented by the graphs indicating the distance between the groundwater-plane and the surface (**Fig. 4.**) and showing the wet-dry points (**Fig. 5.**) it can be concluded that on this segment there are no such points where the groundwater directly supplies the stream with water except for point 22.

The water in the bed originates from the surface onflows. The declining tendency of the WB index can be explained with the fact that the surface water entering the bed leaks away, consequently, it keeps the lower section wet to a declining extent. **Figure 5.** serves also as a proof of this hypothesis. Below point 15 the bed was always found dry at the four samplings. The distribution of the WB2, WB3, WB4 categories (**Fig. 7.**) suggest a similar conclusion. Species connected to WB2 values occur only on the lowest segment of the stream (in small percentage). The percentage of the occurrence of the species connected to WB3, WB4 is increasing towards point 1, while the percentage of the occurrence of the species connected to WB7, WB8, WB9 shows a declining tendency.

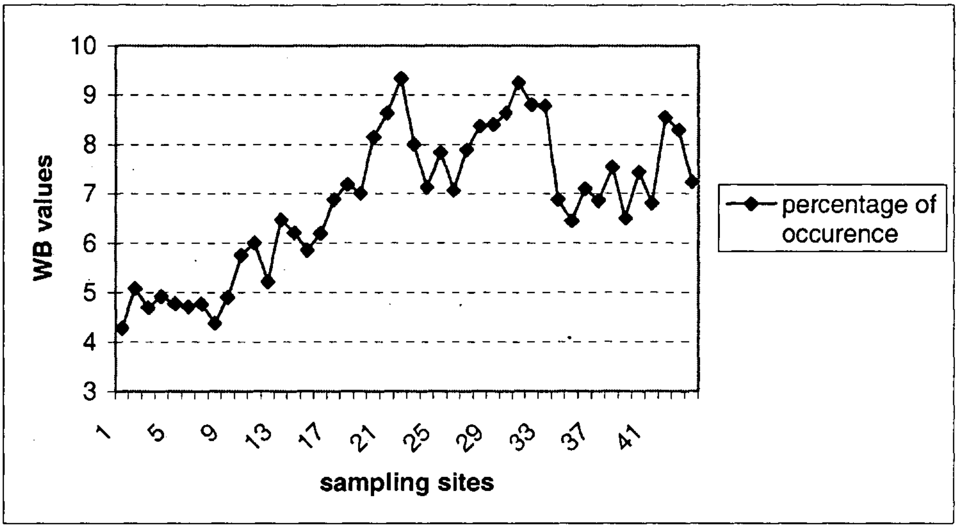
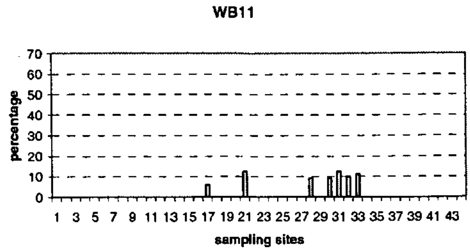
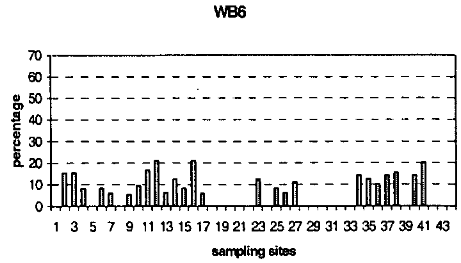


Figure 6. Mean WB calculated from the percentage of occurrence within the group of the coenological samples

The comparison of the segment between point 20 and 23, which was identified on the basis of the data measured directly concerning water supply, with the picture obtained basing on the vegetation is not as unambiguous as the above. Relying on the data recorded in July the low mean of point 26 (7.06) among the four points considered to be springs (22, 26, 28, 30) is especially conspicuous. According to the field minutes a 40 cm long segment of the bed is cut in a depth of approx. 30 cm. The coverage by plants is on this "current line" 0%. The vegetation examined does not characterize the bed bottom but the layers located higher, that is drier levels. Examining the distribution of the WB values based on sampling sites it is remarkable that there are only few places where the species WB2, WB3, WB4, WB5, WB6 occur, and if they occur at all, they cover only a small area, but the species of the category WB7 have a great percentage of occurrence (similar to the species WB8., WB9, WB10.).


WB11
percentage
sampling sites


WB6
percentage
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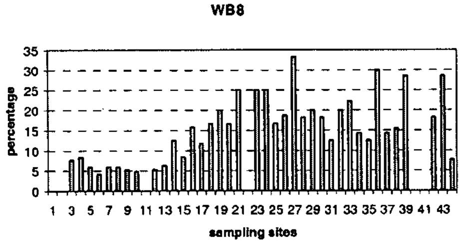
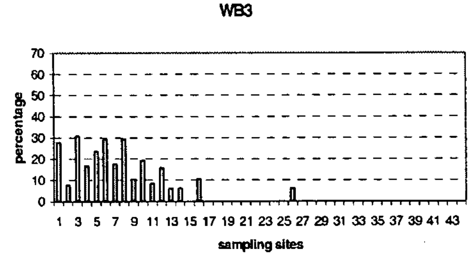
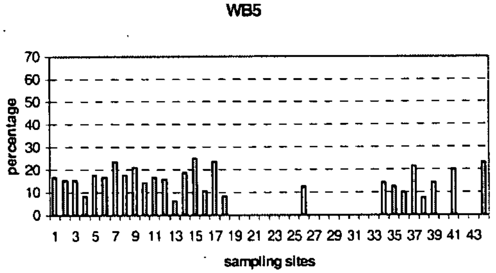
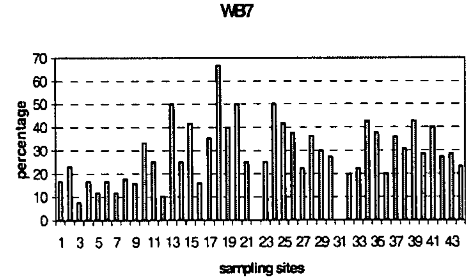
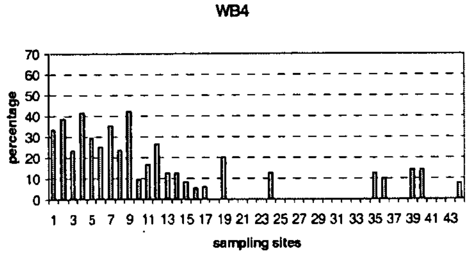
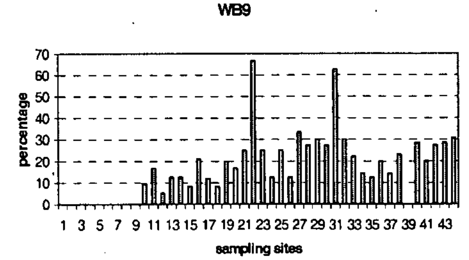

WB8
percentage
sampling sites

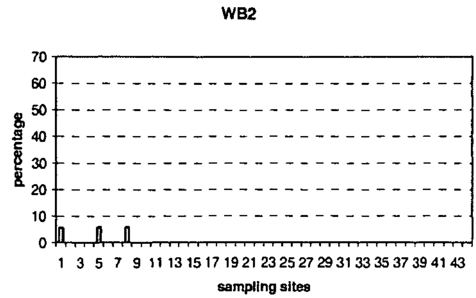

WB3
percentage
sampling sites


WB5
percentage
sampling sites


WB7
percentage
sampling sites


WB4
percentage
sampling sites


WB9
percentage
sampling sites



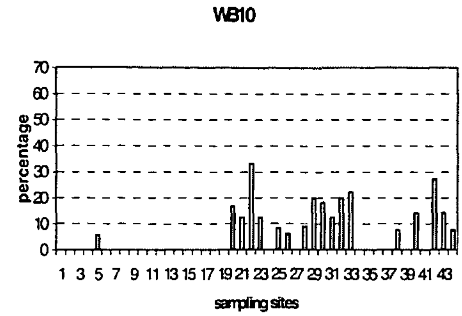


Figure 7. Proportional values calculated on the basis of the percentage of occurrence within the group per WB categories

The mean WB calculated on the segment between point 33 and 44, which was determined on the basis of the date measured concerning water supply, were recorded at the springs in June (points 42, 33). As opposed to the previous group, analysing the distribution it can be concluded that there is no such break to be seen previously as far as the presence and percentage of occurrence of the species of category WB6 and WB7 are concerned.

The depth of the groundwater-plane on the segment from point 19 to 44 (point 26 is left out as a distinct value) measured in June in centimetre is in correlation with means of the WB indexes (percentage of occurrence within the group). The correlation coefficient is 0.81. The relation between the two variables is significant (in addition to a significance of 99%).

Determination of sub-basins

The determined greater sub-basins (**Fig. 3.**) disembogue into the stream bed north of the sampling point 20. The sideward recharge probably decreases on the lower, narrower section of the basin because only a small-sized basin has remained. The data obtained from the groundwater wells have proved this hypothesis since at no sampling times on this section did the groundwater supply the stream with water.

Summary

In our work we aim at discovering the relation between the vegetation system and water supply of a temporary short water course surrounded by fields. We directly record some parameters that determine the water supply (the groundwater depth, soil qualities), while we approach the vegetation by recording coenological data. According to our current data we can conclude that the vegetation of the stream bed (which is difficult to study on the basis of the categories of the syntaxonomical system), it seems to be organized in relation to some measured parameters regarding the water supply.

There is a strong connection between the vegetation examined on the basis of the distance of the groundwater from the bed bottom and on the basis of the mean WB values (percentage of occurrence within the group) of the bed bottom.

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