EFFECTS OF THE ANTHROPOGEN ACTIVITY ON THE WATER- AND SOIL CHEMISTRY IN LAKE NAGYSZÉKSÓS (MÓRAHALOM, HUNGARY)

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Abstract: Nowadays natural habitats are imperilled because of human landscape-transformer processes and negative effects of climate change. The wetlands are sensitive to changes in their environment, their degradation time is 5-10 years, their recovery time is 10-30 years (Szabó, 2004.) Watery habitats belong to the most vulnerable lands because low rate of anthropogenic effects can lead to significant and fast changes in these places. The condition of Lake Nagyszéksós and the anthropogenic effects indicated by physical-chemical processes were studied in our work. The studied saline area reflects well the regional environmental and climatic changes. Soil- and water-chemical measurings and examinations were carried out. In this paper we present a part of ones. On the basis of the investigations we compiled parameter maps of the studied area which were useful revealing of (1) the sensitive areas, (2) changing of the nutrients ratios and (3) the changes because of the cultivation of the neighbouring fields. Our results are help (1) to operate of the water buffalo pilot ecofarm (2) to determine the new rehabilitation plans and (3) to define the quantity and type of the new turism investments.

Keywords: saline lake, soil- and water chemistry, anthropogenic effect

Introduction

Lake Nagyszéksós lies on Dorozsma-Majsa sand ridge region, on the largest sunshine contain field of the country (Marosi & Somogyi, 1990). The humidity is very low (~ 64%), because of the law precipitation (550 mm) the average annual water deficit is estimated at 150 to 175 mm (Raknoczai et al., 2003). The surface water network is a channel system which was formed at the inland drainage. The water management and the salt balance conditions were formed by Széksóstó main channel significantly. The main channel was built for diverting of the spring inland water. The lake was fish pond in the 70's. The drying was started in 1989, and almost there was not open water surface in 1992. Continous reed and bulrush covered the bed of the lake around 2000. The invasive plant specieses displacing the local flora and fauna. These plants are the main sources of food for the water buffalo (*Bubalus bubalus*) so this animal species is capable of maintaining a natural state excellently. Sustainability project was closed with the Kiskunság National Park in 2012. The aim of the project was rehabilitation of the protected sodic wetland. In our work we investigated (1) the condition of the Lake Nagyszéksós, (2) the changes caused by the buffalo reserve and (3) the chemical processes indicated by antropogen effects (agriculture, little farms near the lake).

Materials and methods

For getting to know soil- and water chemistry of Lake Nagyszéksós area, the samples were collected on 5th-6th of April in 2012. Every sampling point was

appointed by EOV coordinates (297 water and 29 soil sampling points). Water samples were collected from 10 cm under the water surface (glass and PET bottle, 2 x 0,5 litre). Electrical conductivity (EC) and pH of water samples were measured on the scene. Conserving was carried out by a high purity nitric acid (pH 3) and samples were stored in 4^{o}C. Soil samples were collected from genetical horizons. The red border-line marks the complete studied area and the blue border-line means the water covered fields on the Figure 1. Chemical data were measured by Hungarian Standards from water samples and Lakanen-Erviö soil extracts. Electrical conductivity (MSZ EN 27888:1998; MSZ-08-0206-2:1978) and pH (MSZ 1484-22:2009; MSZ-08-0206-2:1978) were measured by potentiometric method. Nitrate (MSZ 1484-13:2009. (5.2.)) phosphate (MSZ 448 18:1977.(6.1.); MSZ 448-18:2009) and organic matter (MSZ 21470-52:1983) contents were determined by UV-VIS spectrophotometry. Potassium-, magnesium-, zinc- and copper-ion (MSZ 1484-3:2006. (6.); MSZ 20135:1999) concentration measurements were carried out by Young Lin AAS. Surfer 9 was used for evaluations.

Results and discussion

Distribution maps of soil and water chemistry parameters complement each other perfectly. Areas are characterized by high pH values and they show the typical alkaline wetland image. There are 0,8-1 unit differences between the pH values of soil- and water samples in the studied area (a). On the distribution map of the EC the high concentration spots show clearly the way of the soil solution with higher solute content from the high-lying cultivated fields and farms to the lake (b, f). There is a field with lower EC on the east side of the lake, where is the dredging away mud. The soils have lower EC than the water samples because the EC was measured from the leaching horizon of the soils. The spots with higher EC are located on the south-east part of the agricultural areas because of the runoff conditions of the area. There is a spot partly in the water on the third of the west coast. This is the deepest pont of the coast and the salty water is "trapped". The ferruginous limestone benches hinder the downward leaking under the surface. The total dissolved salt contents are high which characteristic of the saline water areas typically, it is up to 4000 mg/l in the south-eastern part of the lake. The incoming water of the channel has lower dissolved ions, but it doesn't show big differences between the lake water on the middle part of the lake. Watering is solved with drilled groundwater wells on the area, but the water quality in not appropriate all times (and the removed water quantity is not followed from the unlicensed wells), because of this the salinity is growing on the surface. The water and the soil phosphate contents show a difference of two orders of magnitude (c). One of the causes of the big differences, that the aquatic organisms use the phosphate very fast. In the soils one of the determined factors is the intensive nutrient supplying of the adjacent cultivated fields. Sources of the excess phosphate are assumed from organic and/or artificial fertilizer. The phosphate is "trapped" in the lower recess above-mentioned on the middle part of the west side. On the east coast the higher concentration of spots are appeared just where the farms or the cultivated fields go down to the lake. On the southern part of the studied area are the buffalo herd's feeding and one of the resting places. It seems the presence of buffalos has not major impact to the phosphate content of soils and it didn't influence the phosphate circle in greater extent. The buffalos are

sometimes fed, so phosphate and organic matter contents of other plant materials are appeared which comes from another places and the natural circles of the elements change in the area. This extra feeding allows to maintenance the larger number of buffalos over the natural carrying capacity, but the area becomes very sensitive the changing in the number of individuals.

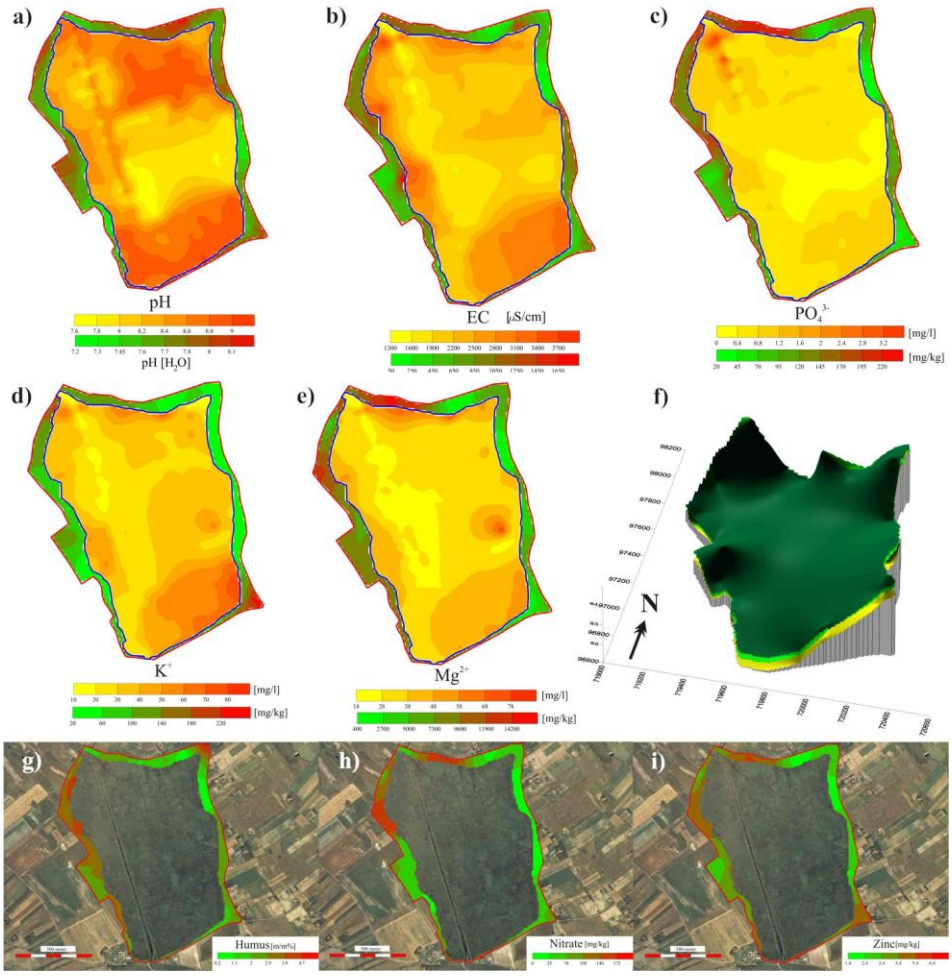

Figure 1. Distribution maps of pH (a), EC (b), phosphate- (c), potassium- (d), magnesium- (e), humus- (g), nitrate- (h) and zinc-content (i) and the surface of studied area (f)

The amount of nitrate did not exceed the detection limit in the water samples. The nitrate ion is presented in a small amount. A part of its is taken up by plants and the other part is taken up by the micro-organisms rapidly from the water. Because of this we couldn't reveal the nitrate loading. The reed cutting and transporting from the fenced

field cause nitrogen loss in every winter on the studied area. The higher nitrate content zones are adjacent to the cultivated fields (h). The humus content is the largest (> 4.7%) in the northeastern corner, which is a marshland (g). Other areas with high organic content (> 2.9%) can be seen on the west side where the richest vegetation (reed) is. Potassium is easily washed out macro nutrient, and it is flowing from the higher lying cultivated sandy soils toward the lower lying areas, like the other examined elements. The flow zone of big potassium containing solutions is signed by the higher potassium concentration spots (d). This zone is lying on a saddle point of the surface between two higher in the north-western peak. The magnesium is micronutrient, three orders of magnitude are hugged by one's measured concentrations in the soil and the water. The distribution pattern indicates that the magnesium is flowing in the soil solution from the higher lying cultivated sandy soil areas (e). Limestone benches prevent the magnesium migration to the deeper layers and magnesium is also dissolved from the limestone benches on the western areas. The high zinc concentration spots are near the cultivated fields (soil and leaf fertilization). The location of spots suggests that they extend into the areas of the lake is covered with water (i). The zinc is linked with aluminum and iron oxides mainly in soils. The latter can be found in large quantities over the limestone benches on the west coast.

Conclusions

Sustainable rehabilitation process of waterside habitats - which is proven to be effective on saline wetlands - was never before tested and submitted to scientific analysis. The application, development and spread are hindered without these tests. We had possibility to examine the full area of Lake Nagyszeksós in a same time with the successful buffalo rehabilitation pilot project. Our results provide possibility to (1) map the natural and anthropogenic influences, (2) monitoring the chemical changes on the area after the colonization of the buffalos and (3) explore the complex environmental and natural processes and anthropogenic activities, natural and economic resources through the chemistry.

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