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The Impact Knowledge of the management practices for medicinal plants biodiversity

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Abstract

The study has three main objectives: validating regional soil quality monitoring standards against soil productivity potential; determining the productive potential of the land for vegetative growth; and understanding how soil porosity and site organic matter interact to regulate long-term site productivity. The biotope features is determining the vegetation type.

Usually the soils have a natural charge of heavy metals originating from the native bedrock chemical composition. The heavy metals are determining the presence or the absence of some certain species in the vegetation habitat influencing biodiversity, some of the species being indicators for some metals growing and spreading better in the presence of the increased concentration of them. The purpose of this work is to show the interrelation between the concentrations of heavy metals in soil and the vegetation habitat biodiversity.

Soil and vegetation samples were taken according to the authorized general procedures. From the mineralized samples, heavy metals concentration was determined by atomic absorption spectrometry. The results obtained were compared to the reference soil and vegetation samples taken from a mountain area considered unpolluted. Some metals are determining a powerful decrease of the vegetation biodiversity the greatest impact being determined in the case of copper, nickel and zinc.

Keywords: plant species biodiversity, biotope, heavy metals, influence

1. Introduction

Natural resource management practices directly affect the intensity of pressures on biodiversity and other land resources. The causes of declining biodiversity and land degradation are often multiple, complex and usually involve a combination of human and natural factors [9]. Environment pollution is a very important problem because it affects ecosystems' and people's health [13]. This is a very popular issue especially because of the conditions imposed by EU, conditions to which we will have to adapt and respect. In this context, we mention that heavy metals environment pollution is quite frequent in industrial and non–industrial areas [17]. In order to reduce heavy metals concentration legal principles were proposed to limit the use of heavy metals gas [21]. In time, heavy metals are cumulated in the soil and will get into water, vegetation animals [3] and in the end in human food, which is an important entrance pathway in the human body [4].

Due to these reasons, in most countries, legal principles were adopted in order to establish accepted maximal limits for chemical pollution factors in soil, water, plants, and food [16]. This work analyses the evolution of the biodiversity indexes in six plant species.

The main purpose of this research is to show the variation of the biodiversity index according with

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the heavy metal content of the soil [7]. Morphologic and anatomic adaptation of the plants to environmental factors is noticed and studied for a long time [19]. Plants have in soil a lot of different nutrients available, those having a divert accessibility degree [10]. The mineral fraction of the soil has a nutrients supply with reduced accessibility for plants, and the organic fraction is representing the main supply source for plants [1]. The potential stock of the nutrients from soil is not representing a stable measure [11]. This is depending by a range of factors as are: the soil type, the bedrock, the granular structure, soil reaction, climatic conditions and the nutritional particularities of the every plant [14]. In the last time the scientist are more interested by the identification of the adapting system of the plants for environmental changes with the help of the bioindicator species [22]. They are looking to find the ecologic state of the environment using these species, and also to use these plants to nature preservation [15]. These can be used for landscape diagnosis; in this way the indicator and hipper-accumulator species are tolerant, studies showing the presence of some certain genetic mechanisms responsible for this thing [22]. Some examples for metal tolerant species are *Holcus lanatus, Agrostis capillaris, Mimulus guttatus* and *Silene vulgaris*. The hipper-accumulators are from 45 botanical families, but the most of them are from *Brassicaceae* botanical family [18].

2. Materials and Method

The study case is based on an example of assessing the spatial distribution of soil contamination with nutrient in Banat's area (western Romania Region).

Soil samples were taken according to the general procedure. Soil samples were taken from the surface and at 20 cm from the surface using an agrochemical device. The quantity of prelevated soil was between 200–300 g. In the mean time, plant samples were also taken.

After sample prelevation, sample documentation was made. It contained: date, place were samples were taken, depth for soil samples, meteorological conditions, purpose of the analysis and type of pollution in that area.

For comparison, soil and vegetation samples were taken from a mountain area that we considered not polluted, but in the end, after analysis were performed, a quite high content of lead was determined. Soil and plant samples were dried at room temperature.

Plant samples were cut into small pieces and passed through a shingle of 150 µm.

The data are collected from 6 plant species from western Romania these being: Foieni (1), Saravale (2), Beba Veche (3), Gradinari (4), Varciorova (5) and Brebu Nou (5) during three years (2008–2010). Granular analysis is realised in two ways concerning the pre-treatment methods, depending by the amount of organic matter from the soil samples. In the case of the samples with more then 5% organic matter this is oxidized with oxygenated water 6% and the dispersion is realised with potassium hexametaphosphate 10% or sodium hydroxide to each boiling after Kacinski. In the case of the samples with less then 5% organic matter there is realised only dispersion with potassium hexametaphosphate 10% solution.

Granular fraction determining is made with dropping method in case of the fractions smaller then 0.002 mm and is humid sifted (0.02–0.2 mm) and dry sifted (>0.2 mm). The results are expressed as percentage from the material remained after pre-treatment. Mineralogical composition of clay fraction (<0,001mm) is realised through the X–ray diffraction on oriented samples saturated in calcium and glicolate [2].

Chemical and biochemical features:

– Total nitrogen (N) is determined with Kjeldahl method through desegregation with H_2SO_4 at 350°C with potassium and copper sulphate catalyser;

– Lime ($CaCO_3$) is determined with gas-volumetric method Scheibler;

– Soil reaction (pH) is determined with an electrode combined with glass and calomel in aqueous suspension with the report soil/water of 1/2.5;

– Total phosphorus (total P) is determined through desegregation with sulphuric acid and percloric acid and colorimetric dosed with methylene blue after Nicolov method (reduction with ascorbic acid and stannous clorure);

– Accessible phosphorus (mobile P) is determined with Egner–Riehm–Domingo method and colorimetric dosed with molybdenum blue after

Murphy–Riley method (reduction with ascorbic acid);

– Accessible potassium (mobile K) is extracted after Egner–Riehm–Domingo method and is dosed with flame photometry; (Hodson, et al. 2001)

– Content in microelements total forms is determined through mineralization with a mixture of nitric, sulphuric and percloric acid (2:0.1:1) and dosed through atomic absorption spectrophotometry (***Standard SR ISO 11047. 1999, [23]).

Vegetation is analysed with geobotanic and square meter method. [12]. The second method allows the determination of some vegetation quality indexes of the plant species as are pastoral value and specific frequency, the last parameter being dependent by the species multiplying mode. This method facilitates also the calculation of some ecological indexes of the vegetation as are Shannon–Weaver biodiversity index and dominance index Simpson [5].

3. Results and Discussion

Soil quality is the foundation of sustainable crop production. While it is true that soil testing serves the purpose of monitoring soil; testing focuses mainly on the ability of the soil to provide plant nutrients; it doesn't serve the purpose of measuring overall soil quality. Soil quality assessment helps to determine the status of soil functions and environmental risks associated with production practices. Depending on what we do and how we treat our soil, we may improve or impair long–term soil health and productivity. The soils with increased levels of metals will release toxic metal and to determine the death of many plant species. Also there are certain plant types that can grow and develop in the presence of some toxic elements, these species being named in literature as tolerant, indicator or hipper-accumulator plants. These plants are accumulating during their life cycle increased amounts of toxic substances, usually metals or metalloids without changes in their chemical composition and without visible toxicity symptoms [8].

Analyzing the obtained results, it is observed that heavy metals concentrations in soil and plants differ from one area to another. Soil quality has been defined as the capacity of a specific kind of soil to function with its surroundings, sustain plant and animal productivity, maintain or enhance soil, water and air quality and support human health and habitation.

Physicochemical features and heavy metal concentrations of the soil samples of the studied plant species are presented in Table 1. Management systems have been historically adopted without recognizing consequences on soil conservation and environmental quality, and therefore significant decline in soil quality has occurred worldwide. The biological attributes, along with the trace metals concentration, appear to be most sensitive to soil conservation/restoration and management practices. Biodiversity expressed as the Shannon–Weaver index from the analyzed plant species has values comprised between 2.63 (Saravale) and 4.68 (Gradinari), this meaning that the analyzed plant species have a divert biodiversity index, from medium diversity to great diversity of the vegetation habitat. The total number of species in studied plant species is represented as it follows in Figure 1.

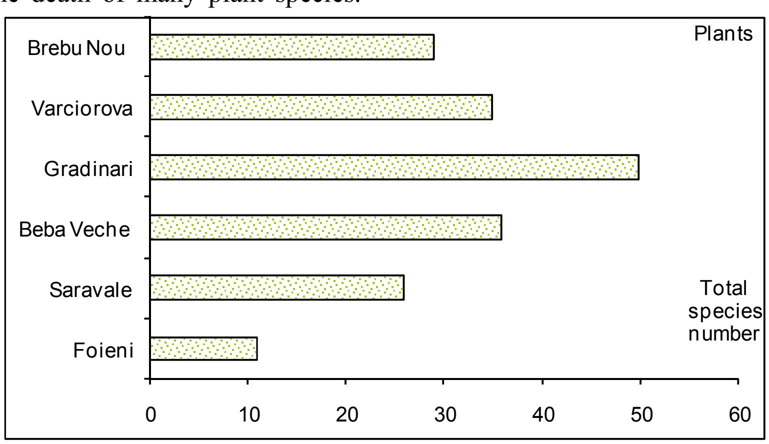

Figure 1. The total species number from studied plants

Table 1. Physicochemical soil features and heavy metal content in the analysed plant species

No.	Physicochemical feature	(1)	(2)	(3)	(4)	(5)	(6)
1.	pH in water	7.09	7.74	7.54	5.13	4.94	6.08
2.	$CaCO_3$%	Nd	1.39	1.44	Nd	Nd	Nd
3.	Coarse sand (2–0.2mm)%	21.2	0.5	0.5	21.9	5.1	2.1
4.	Fine sand (0.2–0.02mm)%	48.3	45.9	46.8	42.5	4.0	43.2
5.	Dust I (0.2–0.01mm)%	13.8	17.0	16.0	17.5	35.0	25.0
6.	Dust II (0.01–0.002mm)%	16.7	33.5	36.7	18.1	19.9	29.7
7.	Clay (under 0.002mm)%	25.0	47.2	45.7	30.0	43.5	42.4
8.	Humus %	1.10	2.68	3.63	9.49	7.67	9.30
9.	P ppm	20.8	84.6	84.6	7.0	8.6	5.4
10.	P ppm calculated	17.51	58.54	58.54	7.0	8.6	5.4
11.	K ppm	114	155	155	103	130	147
12.	N total %	0.18	0.60	0.60	0.98	0.74	0.71
13.	Cu (ppm)	13.92	13.92	13.92	21.11	6.54	10.76
14.	Zn (ppm)	75.8	75.8	75.8	72.05	69.4	49.73
15.	Ni (ppm)	26.2	26.2	26.2	25.6	17.08	30.51
16.	Pb (ppm)	15.1	15.1	15.1	28.99	37.92	24.05
17.	Co (ppm)	6.25	6.27	6.27	7.88	7.80	12.54
18.	Cr (ppm)	31.99	31.99	31.99	46.05	30.53	33.33
19.	Cd (ppm)	Nd	Nd	Nd	Nd	Nd	Nd

Nd–not detected

The situation concerning the participation in the vegetation habitat of the different technological groups of plants shows a great variation this being represented in figure 2. As is shown in figure 2 the species from other botanical families' number is greatest in comparison with the other plant group. Legumes are missing from two of the analyzed plant species, and the *Cyperaceae* and *Juncaceae* from one. The heavy metal concentration from the upper layer of the soil is correlated with the biodiversity of the vegetation habitat of the plant species (Table 2). Analyzing the values obtained after the calculus of the correlation coefficient between the heavy metal concentration and Shannon–Weaver index we have obtained different data. The closest values are obtained for copper, zinc and nickel, respectively $r = -0.68$, being followed by heavy metals ($r = -0.58$).

The negative value of the correlation coefficient show an inverse correlation, so in the cases of copper, zinc and nickel the increase of the metal concentration in soil is heavy metal sing to the decrease of the Shannon–Weaver index.

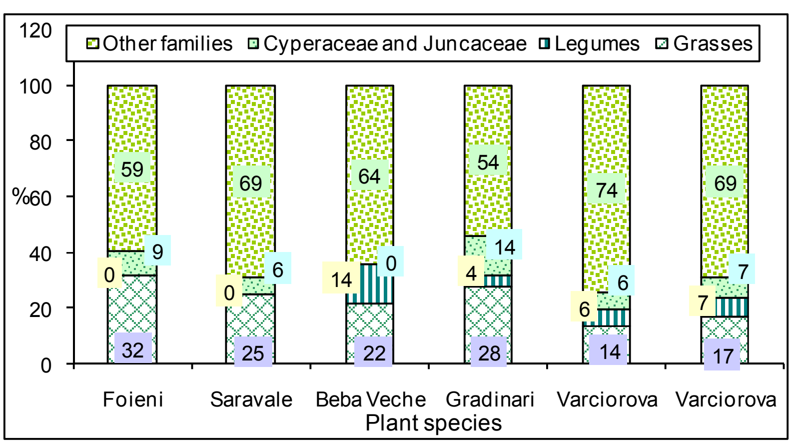

Figure 2. The participation in the vegetation habitat of the main plant groups from plant

Table 2. Correlation coefficients between the heavy metal concentrations and biodiversity

Metals	Cu	Zn	Ni	Pb	Co	Cr
r	–0.68166	–0.68169	–0.68169	–0.57571	–0.31059	–0.424

4. Conclusion

The analyzed plant species show different soil and vegetation conditions. Thus, the vegetation habitat has a different number of species. The percentage of different species from the total species number of the plants is represented by species from other botanical families. Heavy metal concentration varies in soil and plants with the area.

Analyzing the results obtained in this research we can conclude that the heavy metal content in the upper layer of soil determinates the decrease of the biodiversity index (Shannon–Weaver) in the case of copper, zinc and nickel. Plants are key soil or plant community characteristics that are sensitive to change in the environment. They reflect complex ecosystem processes that are too difficult or expensive to be measured directly.

They provide information about the current status of rangeland ecosystems. Trends from plants measured regularly provide clues about the response of the system to management. Soil quality indicators complement vegetation indicators and may be qualitative or quantitative. Management practices can be used as indicators of condition, especially for extrapolation across wider areas, providing they are backed up by representative site-specific monitoring and analysis of their effects on resources and ecosystem functioning.

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