DIVERSITY AND CHARACTERISTICS OF FOREST SOILS FROM SĂLAJ COUNTY

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Abstract
It is well known that the forest soils represent the key element of the forest site, the knowledge of their diversity and characteristics being crucial for a sustainable forest management perspective. The purpose of this study was to highlight the diversity of the forest soils from Sălaj County. Special attention was also given to typical soil characteristics, such as soil pH and humus content. Data from the forest management plans issued between 1989 and 2012 of the state-owned forest districts within Sălaj Forestry Directorate were taken into consideration. The most common forest soils across Sălaj County were the preluvisols, luvisols and eutric cambisols. High amplitude was recorded both in the case of the soil reaction and humus content. In general, the forest soils across Sălaj County are favorable for the main tree species from the region, namely the oaks, mainly pedunculate oak (Quercus robur L.), sessile oak [Q. petraea (Matt.) Liebl.] and Turkey oak (Q. cerris L.), and the beech (Fagus sylvatica L.).

Keywords: eutric cambisol, forest soils, luvisol, preluvisol, Sălaj

1. INTRODUCTION

In Romania, the first official attestation of *Pedology* as a science dates from 1906, when an agro-geological section was created within the Geological Institute, being managed by Gheorghe Munteanu Murgoci (Dincă et al., 2014).

Almost seven decades later, the Institute of Pedology Studies and Research was established through the Decision of the Council of Ministers no. 565 from 6th of May 1970. Nowadays, the institute is reorganized in National Research and Development Institute for Soil Science, Agrochemistry and Environment – ICPA Bucharest. This institute is under the coordination of the Ministry of Education and it is responsible for the scientific coordination of the national network of 37 county offices (Simota et al., 2017).

The research in the field of forest soils started in 1930, when three laboratories (*i.e.* Soils, Botanics and Entomology) were set up within the Autonomous House of State Forests (CAPS). The research was intensified three years later, when Forest Research and Experimentation Institute was set up (Doniţă and Biriş, 2003). After one decade, around 1940s, the designing of the map with the distribution of the forest soils at national level began, the main responsible being Constantin Chiriţă (Munteanu et al., 2005).

Currently, the forest soils are studied and monitored by researches from "Marin Drăcea" National Institute for Research and Development in Forestry in specialized laboratories. The research was intensified starting with 2008, when the first cycle of the National Forest Inventory began, between 2008 and 2012, more than 6.000 soil profiles being analyzed (IFN, 2016).

According to recently published data regarding the distribution of the forest soils at national level, dystric cambisol is the most common forest soil type (more than 2.2 mil. ha), followed by haplic luvisol (1.4 mil. ha), eutric cambisol (0.86 mil. ha), entic podzol (0.44 mil. ha), preluvisol and fluvisol, both with approximately 0.33 mil. ha (Dincă et al., 2014). Since the distribution of the forests across Romania is uneven, some forest soil types are more or less common across the countries.

Sălaj is a county dominated by hills and valleys (Karácsonyi et al., 2017), with a very rich fauna, represented by several species of beetles (Kutasi and Szél, 2016), wasps and ants (Vas et al., 2016), spiders (Szita, 2015), earthworms (Szederjesi, 2015) and small mammals (Gubányi, 2016). The flora is also very diverse and rich (Szatmari et al., 2017), including 16 species of Community Interests, 13 species from the Romanian Red Book and 124 taxa included in the National Red Lists of Romania (Negrean et al., 2017). On the contrary, Sălaj is deficient in woody vegetation (Rosculete et al., 2018), the forest lands accounting for 94.800 hectares, out of which 88.500 hectares are composed by hardwood species (INS, 2018). Two thirds of the forests across the county are managed by Sălaj Forestry Directorate, a territorial branch of National Forest Administration - Romsilva.

The aim of this study was to highlight the diversity and the main characteristics of the forest soils across Sălaj County.

2. MATERIALS AND METHODS

Information regarding the forest soil characteristics was centralized from the forest management plans (FMPs) of the six forest districts within Sălaj Forestry Directorate, namely Almaş, Cehu Silvaniei, Ileanda, Jibou, Şimleu Silvaniei and Zalău. The forest management plans were issued between 1989 and 2012 (Anonymous, 1989-2012). At every ten years, the FMPs are updated, and new forest soils samples are analyzed in order to determine their main physical-chemical properties, based on national and international methodologies (Dincă et al., 2012).

For this study, the characteristics of 252 soil profiles and 653 pedogenetic horizons were analyzed.

3. RESULTS AND DISCUSSIONS

Forest soils across Sălaj County

The most common forest soil types across the forest lands managed by Sălaj Forestry Directorate were the preluvisol (37.5%), luvisol (26.9%), eutric cambisol (26.9%), followed by phaeozem (4.3%) and other soil types (Figure 1; source of the photos: Târziu et al., 2002).

These results are in line with the statistics of the distribution of all types of soils at county level, according to which the luvisols accounted for more than a half of the territory of Sălaj County (Păcurar et al., 2007).

Soil pH

The soil pH (soil reaction) was calculated for every pedogenetic horizon for the three most widespread soil types. Preluvisol had an average value of 4.74 in Ao horizon and 5.40 in Bt horizon, respectively. The pH value in the case of luvisol was 5.4 in Ao horizon, 5.09 in El horizon and 5.52 in Bt horizon, respectively. Eutric cambisol had an average pH value of 5.52 in the Ao horizon and of 5.75 in Bv horizon, respectively (Figure 2).
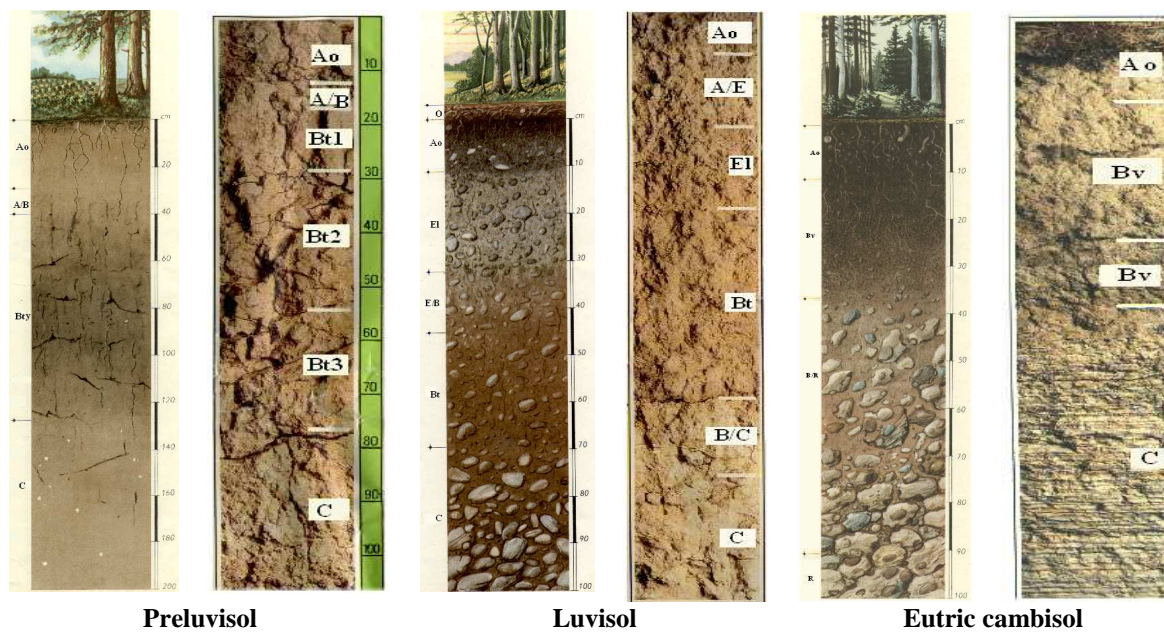
Preluvisol　　　　**Luvisol**　　　　**Eutric cambisol**

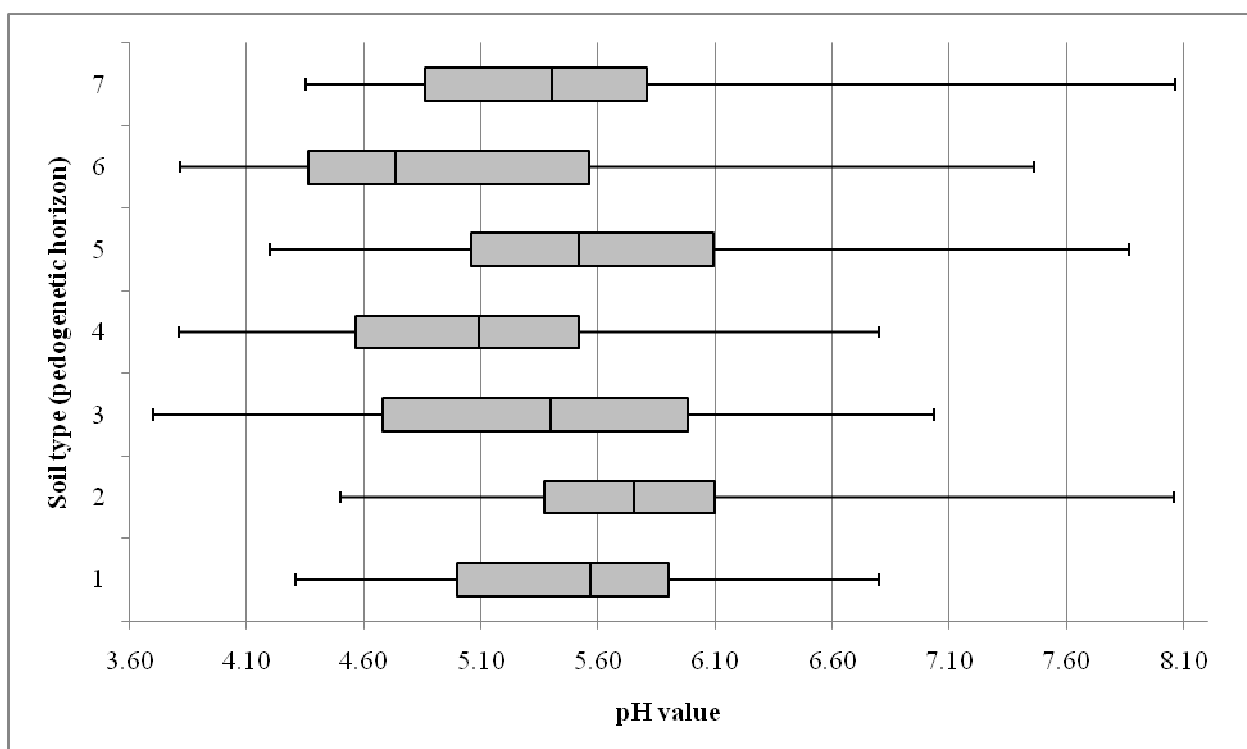*Figure 1. The main forest soils across Sălaj County*

Figure 2. Box and Wisker Plot of the pH variation of genetic horizons for the most widespread forest soils across Sălaj County: 1- Eutric cambisol (Ao), 2- Eutric cambisol (Bv), 3- Luvisol (Ao), 4- Luvisol (El), 5- Luvisol (Bt), 6-Preluvisol (Ao), 7-Preluvisol (Bt)

In general, the forest soils across Sălaj County are moderately to strongly acid. These results are similar with a paper published around ten years ago, in which some recommendations regarding the valorification of these types of soils with low pH values were highlighted (Păcurar et al., 2008).

Soil base saturation
In the case of the eutric cambisols, the average value of the base saturation degree (V) was 71.39% in Ao horizon and 76.59% in Bv horizon, respectively, being slightly bigger than the values reported for the eutric cambisols across the forest lands managed by Maramureş Forestry Directorate (Crişan et al., 2016).
Luvisols had a V value of 62.42% in Ao horizon, 51.76% in El horizon and 70.73% in Bt horizon, respectively, being mesobasic soils.
Preluvisols had a V value of 42.92% in Ao horizon and 61.81% in Bt horizon, respectively, being oligomesobasic soils. In the case of the preluvisols from Cluj County, the values recorded for the base saturation degree were higher (Enescu et al., 2017).
The smallest variation of this parameter was recorded in the case of the eutric cambisol, while the largest in the case of the preluvisol (Figure 3).
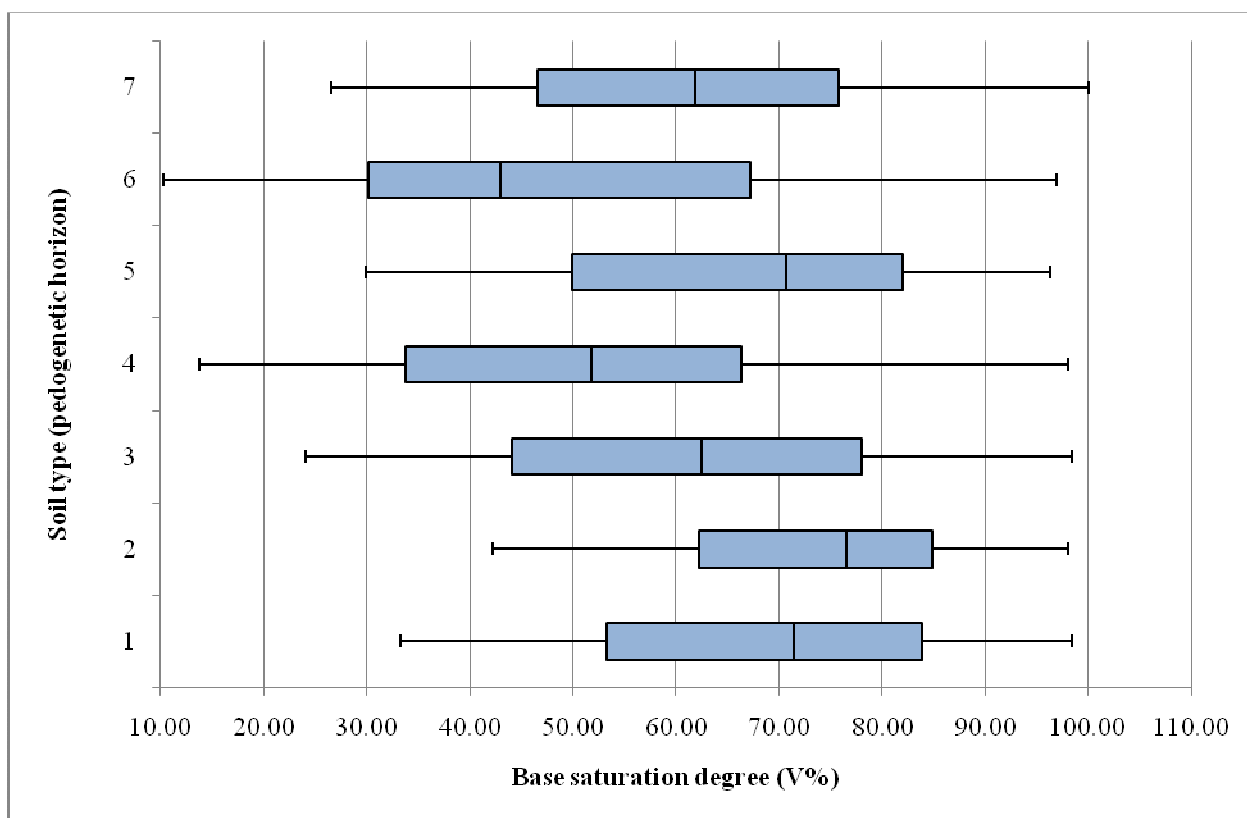

Figure 3. Box and Wisker Plot of the Base Saturation degree (V) variation of genetic horizons for the most common forest soils across Sălaj County: 1- Eutric cambisol (Ao), 2- Eutric cambisol (Bv), 3- Luvisol (Ao), 4- Luvisol (El), 5- Luvisol (Bt), 6-Preluvisol (Ao), 7-Preluvisol (Bt)

Humus
Being well known that the highest share of the humus is found in the first pedogenetic horizon, the variation of the humus content in the case of the three most common forest soils is given in Figure 4.

The average values for all three soil types were smaller in comparison with the ones reported for the same forest soil types in the case of Bihor County (Dincă et al., 2017) and Cluj County (Enescu et al., 2017), respectively.
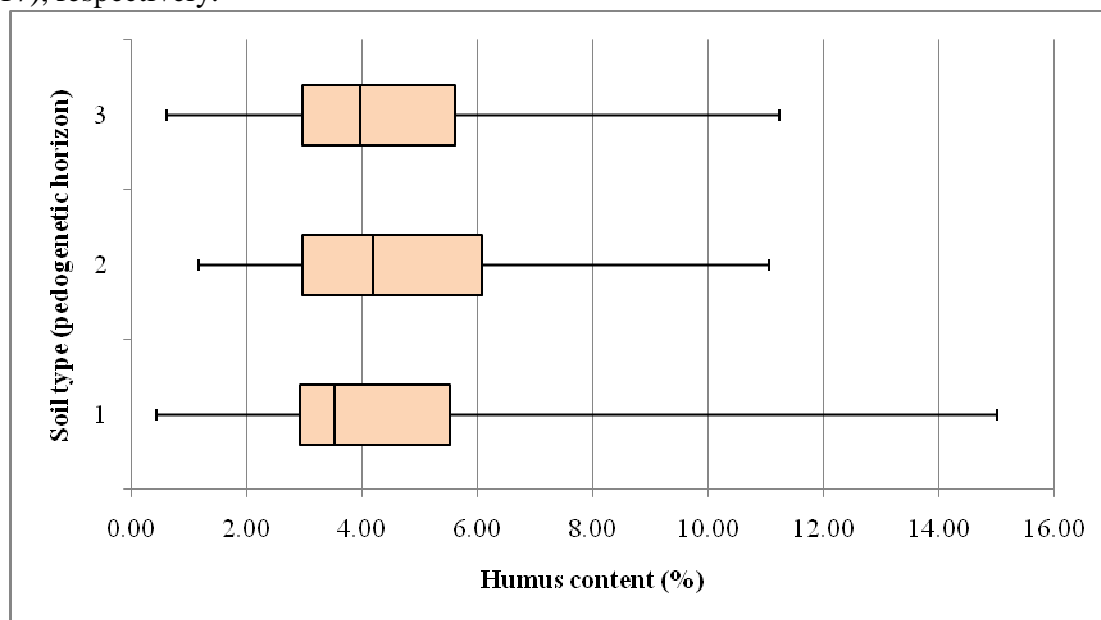

Figure 4. *Box and Wisker Plot of the humus content variation of the first genetic horizon (Ao) for the most common forest soils across Sălaj County: 1- Eutric cambisol, 2- Luvisol, 3- Preluvisol*

4. CONCLUSIONS
Almost all forest soils across Sălaj County belong to Luvisol and Cambisol classes. The most representative forest soils were the preluvisols, luvisols and eutric cambisols.

High amplitude was recorded both in the case of the soil reaction and humus content.

In general, by taking into consideration the values recorded for the pH and for the soil base saturation, we conclude that the forests sites across Sălaj County present favorable conditions for the main tree species from the region, namely the oaks, mainly pedunculate oak (*Quercus robur* L.), sessile oak [*Q. petraea* (Matt.) Liebl.] and Turkey oak (*Q. cerris* L.), and the beech (*Fagus sylvatica* L.). In order to maintain these characteristics, future silvicultural measures should be focused on conserving and promoting the mixed forest stands.

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