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OVERVIEW OF DRAINED FLOODPLAIN SOILS OF THE TRANSCARPATHIAN LOWLAND

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Досліджено ґрунтове різноманіття осушених заплавних комплексів Закарпаття. Встановлено, що ґрунтовий покрив дослідженої території представлений різними підтипами лучнувато-буроземних та оторфовано-глейових ґрунтів.

Вовк О.Б., Орлов О.Л. **Обзор почвенного покрова осушенных пойменных комплексов Закарпатской равнины** // Науч. зап. Гос. природоведч. музея. – Львов, 2008. – Вып. **24**. – С. 51-56.

Исследовано почвенное разнообразие осушенных пойменных комплексов Закарпатья. Установлено, что почвенный покров исследованной территории представлен разными подтипами луговато-буроземных и оторфовенело-глеевыми почвами.

The basins of large rivers, like Bodrog and Latorytsya have got very dynamic systems with essential seasonal and long-term variability. Natural hydro-climatic fluctuations, together with the increased anthropogenic pressure onto the riverbeds and flooded areas create conditions for supporting a permanent change and renovation of all components of the river ecosystems, including soils. Preserving in its structure and characteristics the imprints of orogenesis of the territory, soils of the flooded complexes of the Latorytsya river basin, evolves under the influence of a number of natural and human processes of soil formation which determine in a large scale the character and the way of their transformation. Depends on the type and longevity of development of unused lands, the transformation might be going differently and differently influence its regime, components and characteristics.

Detail soil observations on the Transcarpathian lowland were made in the middle of the last century [1-3, 8, 10, 13, 15], and gave a particular basis to our knowledge of the peculiarities and structure of the soil surface of the region. However, the scientific data obtained at that time lost its importance due to essential changes of the factors, which influence the soil formation. Since that time, the soil surface of the investigated territory went through strong anthropogenic transformations. Around 80% of the territory prolong last few decades already was drained and anti-flood constructions were built and was included into the cycles of intensive exploitation. The soil formation processes got more human-orientated direction what was strongly reflected on the morphology and characteristics of the soil.

Current investigations of the morphology and characteristics' changes of the soil of flooded ecosystems of the Latorytsya River, the research on the influence of land-reclamation and anti-flood measurements onto soil formation processes are very important from the point of view of establishing balanced river valley landscapes. The comparing of new data with the materials obtained during the last century can help us to make important conclusions concerning the current processes of soil formation and forecast possible transformations and soil peculiarities in the future.

Soil studies were carried out during 2003-2005 within the framework of an international Austrian-English-Ukrainian project: "Biodiversity, conservation and sustainable use of the Transcarpathian riverine forests, Ukraine" (WWF, UK 006702P). Analytical processing of the soil data is still undergoing and thus this paper is dedicated to the morphological and landscape characteristics of the soil surface of the floodplain forest territories. The publication of this paper is necessitated by a complete absence of reliable data on the soil characteristics of floodplain ecosystems of the Transcarpathian Lowland.

Material and Methods

The basis for this research is our own data on the morphological, physical, water-physical peculiarities of soils of floodplain ecosystems of the Latorytsya River, which we obtained during our field works. In this paper we used also literature data concerning the relief, climate, vegetation and soil surface of the studied area [8, 10].

According to the chosen tasks, within the complex of floodplain ecosystems of the Transcarpathian Lowland, we had selected the representative areas of „Ostrosh" and „Chomonyn" forests, which include habitats with different conditions of soil formation and different degrees of human impacts. The series of research plots were established within each study site.

In the "Ostrosh" site (which was drained about 100 years ago) we have established the next study plots: 1a – depression with herb layer in alder forest stand; 1b – flat plot in a hornbeam-oak forest, and 1c -- flat plot in a ash-oak forest. In the "Chomonyn" forest site we have established the next study plots: 2a – elevated plot in hornbeam-oak forest, 400 m south-west from meliorated canal with a dike; 2b – flat plot, 200 m south-west from canal with a dike, and 2c – flat plot in oak forest, 20 m away from a canal with a dike.

For soil studies we have used landscape-ecological and morpho-genetical methods [4]. Profiles on the representative plots were made 60-110 cm in depth, by opening all the genetic horizonts of the soil and the upper part of the maternal rock. We made morpho-metrical measurements of the soil profiles with estimation of the height of each layer and morphological description of each genetic horizonts. Samples of the soil were taken for analytical analysis in the laboratory for each genetic layer.

Results and Discussion

The study area is located on the northern border of the Pannonian Lowland and within Ukraine it named as the Prytysyanska Lowland [10]. The territory of the lowland is dissected by many plain rivers with meander riverbeds and with broad valleys. The floodplain parts consist of aluvial-deluvial, aluvial accumulations and dominantly heavy granulometric composition [8]. The Prytysyanska Lowland has formed the unique complexes of floodplain oak and ash-oak forests and in the marsh-ridden parts – alder forests. The vegetation in the flooded parts of the river has a mixed-grassland character with domination of mesophytic elements, while in the dead-arm parts – hydrophilic elements.

The soil surface of the floodplain complexes is formed by soils of different origin and morphology which are resulted by a different ration of different soil formation processes: brown forest soil, turf and eluvia. The process of glay forming is presented everywhere. According to some researchers [2, 3, 10], during the period before land-reclamation on the Prytysyanska Lowland, the next soil types were dominated: brown-clay, turf-clay, meadow-marsh and turf-

alluvial soils and their differently glay varieties. The draining of humid ecosystem started with the aim of their agricultural use about 100 years ago [11, 12]. The drainage system canals divided the territory of the lowland onto separated segments. As the result of transformation of water-air regime the catastrophic changes of the soil structure, profiles and soil peculiarities were occurred and what is the most important – the process of soil formation has been changed as well.

The current soil surface is represented mainly by two main soil types: the elevated elements of the relief are composed by pseudo glay (according to the FAO classification [14]) or typical and glay-eluvia meadow-brown soils (according to the soil list nomenclature of Ukraine [6]), while the low parts – by glay types of meadow-marsh soils [6].

General types of meadow-brown soils spread fragmentally under meadow vegetation or in forests with well developed herb layer. Meadow habitats of the Lowland in dominance is meliorated with open drainage and agriculturally used. Persistent impact of heavy machinery has conducted of worsening its water-air regime, and as consequence it conducted an appearance of glayish features already in humus horizon.

Meadow-brown glay-alluvial soils are the main type of soils in the drained floodplain ecosystems. The formation of soil surface was going on under oak, ash-oak and ash-hornbeam-oak forests with well-developed herb layer. In the literature they are also named as turf-podzol glays, turf-glay and turf-brown forest glay soils [6]. They are forming usually under meadow and forest vegetation under the conditions of permanent surface moistening. In the past these types of soils were distributed on the higher floodplain and above floodplain places, which were not flooded by the flood waters. In our days, due to the construction of dikes and melioration canals, the pseudo glay soils can be found along the floodplain parts of the rivers. The high bedding of soil waters, frequent surface over moistening and the hard granular-metric composition of these soils, caused the formation of pseudo glay horizons, which have formed (by time alternation of reduction processes) mobilization of iron (period of water saturation) and fixation of iron (oxidation processes) during the dry periods [7]. The oxidize-reduction horizons are characterized by the alternation of light spots and stripes, poor in iron, with rusty colored sites rich in iron.

The profile of meadow-brown forest soils distinctly divided into two main texture horizons: the upper friable, eluvia, 20-40 cm high and the lower hard, dense, pseudo glay, iluvia horizon.

According to the level of glay forming and the expression of eluvia-iluvia processes, these soils are divided into 5 subtypes: low glay-, glay- (sampled plot 1c), heavy glay-eluvia.

The morphological structure of the widest spread meadow-brown forest low glay-eluvia soil profiles might be characterized by the profiles sampled at the „Chomonynskyi forest" site, 400 m south-west of melioration canal, on flat plot in a hornbeam-oak forest (sampled plot 2a).

H_o 0-3 cm	The litter composed by oak and hornbeam leaves, dry, weakly decomposed, lower layer well fractured, unstructured, with tree roots.
He 3-6 cm	Dark brown colored, dry, friable, with small-particles structure, light loamy, with a large number of small roots, with a gradual transition.
HE 6-29 cm	Grayish-light-brown, friable, fresh, with small-particles structure, light loamy, with strong roots, along the roots dark-grey colored stripes are visible, with a gradual transition.
IP (gl) 29-49 cm	Brown with rusty spots, with dark-brown ornsteins, condensed, fresh, with small-particles structure, light loamy, with few roots, with a gradual transition.
Pi gl 49-86 cm	Brown with bluish and rusty colored spots, fresh, condensed, with small-particles structure, mid-loamy, ornsteins are occur, rarely roots are present.

The iron, which is redistributed in the pseudo glay horizon, is coming from the upper or neighboring horizons during the vertical or lateral migrations of solutions. Strong richening and high heterogeneity of iron redistribution cause the formation of soft or condensed ornsteins. Accumulation of iron combinations on the limits of soil water standing, the depth of which is regulated by land-reclamation arrangements (construction of canals and dikes), caused the formation of a rare soil-mineral ornstein (petro-ferrous) horizon [7]. Such a horizon type was described by us for the meadow-brown forest, strongly glay-eluvia soil (experimental plot 2b), with the next morphological characters:

ERgGl 30-50cm	Gray-bluish with a large number of iron-manganese inclusions (up to 90%) and with rusty dark brown ornsteins (0.5-2.0 cm in diameter), very condensed, fresh, with small-particles structure, mid-loamy, with rare roots, with a striking transition.

This horizon was formed with nodules and/or large inclusions (gravel, pebbles), cemented by iron-manganese oxides on the concentration level of eluvia materials. The construction of a canal deprived this territory from the seasonal surface floods, and caused a relatively stable level of water soil standing. The changes of the hydrological conditions caused the renovation of the eluvia-iluvia differentiation of soil profiles, what affected the formation of special inclusions (horizon of iron-manganese inclusions) on the border of eluvia and strongly glay iluvia horizons.

In soils, which are formed on elevated types of meso relief under the conditions of well and permanent drainage (drained about 100 years ago), in dead-littered hornbeam-oak forests, the soil formation develops into the formation of brown forest soils. The profile of such a meadow-brown forest glay-eluvia soil (experimental plot 1b) differs by a visible eluvia-iluvia differentiation into a podzol soil type. This type of soil is described for a leveled site in a hornbeam-oak forest in the „Ostrosh" valley:

Ho 0-3 cm	The litter is formed by oak and hornbeam leaves; three layers of mineralization: the upper is formed by freshly falling leaves, the next is formed by a partially decomposed leaves and the lower one – by a well decomposed leaves, lost it structuring, with small roots.
He 3-16 cm	Light brown, friable, with small particles structure, light loamy, with large number of small roots, with gradual transition.
hEgl 16-38 cm	Whitish-grey with rusty spots, condensed, fresh, with large particles, mid-loamy, with gradual transition.
Ipgl 38-80 cm	Grey with rusty spots, with a marble-like structure, condensed, humid, with a monolith structure, which is divided into horizontal layers, hard loamy, with rare roots.

The described soils are similar morphologically to the brown-forest-podzol clay soils of Precarpathians [6] and differ from them by less expressed eluvia horizons. Thus, we can suppose that in the meadow-brown-forest soils, with well drained land-reclamation canals, the peculiarities of the brown-forest-podzol soil formation will be intensified further on.

Soil combinations of different genera of meadow-brown forest soils with meadow-marshy soils are typical for the studied area. Such soils are distributed sporadically, and very often can be find in depressions with a high level of soil waters, under alder forests or meadow-marshy vegetation.

Morphological peculiarities of horizons are characterized by the reduction processes and mobilization of iron under the permanent moistening. Its change during the year and depends from the fluctuations of the soil water level. During the aerobic period on the pore's walls, root tunnels, on the surface of some aggregations rusty spots are formed. This color picture is unstable and after new saturation of the soil by water they usually changed to bluish and green-bluish color.

The morphological structure of a meadow-marshy soil profile can be characterized by the profile sampled in the „Chomonynskyi forest" site (experimental plot 2c) in depression with oak forest stand.

H_0 0-4 cm	Litter formed by weakly decomposed oak leaves, the lower part structured, with roots.
Hd(gl) 4-14 cm	Brownish-grey, with spots of rusty color, fresh, friable, with small-particles, mid-loamy, with a large number of small roots, with distinct transition.
Hgl 14-27 cm	Dark grey, with spots of rusty color, friable, fresh, with small particles, divided by vertical cracks, mid-loamy, with ornsteins and iron-manganese inclusions, with rare roots, with gradual transition.
Phgl 27-55 cm	Grey-bluish, with a large number of rusty spots, condensed, humid, with large particles, which are divided onto horizontal plates, hard loamy, with rare roots and ornsteins, with gradual transition.
Pgl 55-71 cm	Dark grey-bluish, with rare brownish spots, condensed, without structure, hard loamy, with small ornsteins, roots are absent.

Meadow-marshy soils contain of rocky layers of heavy granulometric composition and have got a deep soil profile – not more than 40-50 cm. The profile is lightly separated onto genetic layers, with strongly expressed 14 cm deep Hd horizont, and with intensively expressed glay peculiarities across the entire profile.

The construction of meliorated canal network within the Latorytsya river basin strikingly changed not only the surface of the lowland but also caused the changes of the dominant soils characteristics. So, in "Chornyi Mochar" Site the anthropogenic agricultural meadow soils have replaced the large meadow-marshy ecosystems. These anthropogenic soils have got new soil subtypes of meadow-marshy soils, which have been described by scientists as torf-glay meliorated soils of the Central part of the "Chornyi Mochar" [6]. So, in 1981, here, in first time have been identified and scientifically described the genetic consequence of large scaled human impact activities.

Thus, as we know, the natural neotectonic processes of the developing of this territory were directed onto sinking of tectonic structures of the Transcarpathian Lowland [5], what affected a gradual elevation of underground and soil waters. By the time, turf-meadow soil formation processes, complicated by glay forming, started to dominate over brown-forest soils [9]. Within the lowland, brown forest soils occurs only on some insular, elevated, well-drained plots [8], while on wide-spread alluvial depressions, which are located above rocky layers with hard granular metric composition. The meadow-brown-forest and meadow-marshy soils are dominated. The essential natural soil formation factors are the floods, which moved on the small-dispersion and very nutritive silt material, which quickly incorporated into the soil processes and gave to the soil distinct alluvial peculiarities.

The natural processes were strongly disrupted by a large-scale melioration work started at the end of 19th century. During a short period, 10-20 years, a wide network of drain canals and

dikes was built, which helped to include large territories into agricultural production but at the same time, essentially changed the hydrological regime of the soil surface. Alluvial soils were drained and the process of sediments accumulation was stopped. A striking decrease of soil waters caused the weakening of glay forming processes in the upper layer of the profile and the revealing of pseudo glay processes and formation of ornstein layers on the border of aerobic and anaerobic parts of the soil profile. By the time in the profile of meadow-brown-forest soils eluvia-iluvia characteristics has appeared, which caused the reconstruction of the profile according to the podzol type. Thus, in the background soil formation on drained territories, the brown-forest-podzol processes started to dominate.

Conclusions

Even a small human impact on natural soil development process can conduct the changes in morphology and peculiarities of alluvial soils. Long-term hydro melioration period has lead to forming of unique variants of natural-anthropogenic soils, which have replaced natural soils. Complex soil studies on natural and meliorated floodplains give a chance to identify genetic potential of modern soil development process, and consequently, the stages of whole ecosystem development. Only on such basis it is possible to identify the etalons of studied soils and to develop measures to protect them.

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