

USE GIS FOR LANDSCAPE ANALYSIS OF CIULUCURILOR HILLS

BY

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Abstract. The research shows that the structure of parental rock is an important factor in formation and distribution of forest and steppe landscape in the Ciulucurilor Hills along with climate conditions and landscape, represent and nature of parent rock.

Key words: GIS, landscape, spatial, type soil.

1. Introduction

Sustainable environmental management entails work on the improvement of spatial landscape structure through various activities, including the completion of the afforestation. The process of creating new forest plantations requires addressing specific types of forest landscapes depending on geocologic conditions [1]. The purpose of the research is to assess environmental conditions, which determine the spatial distribution of our common forest landscapes using geographical information systems.

2. The Object of Study and Methods

The study focused on the specifics of landscape allocation in Ciulucurilor Hills, a region located in north-central part of Moldova, in river basins of Soloneț, Ciulucul Mare, Ciulucul de Mijloc and Ciulucul Mic the left tributaries of the Răut river. In the East and South the Ciulucurilor Hills are limited by the Dniester and Codri plateau units, while in the North and West –

by the Middle Prut River Plain and the Balti Plain or Cubolta Plain. As for the relief's morphological and morphometric specificity, modeling processes, the annual amount of precipitation, etc. Ciulucurilor Hills have much in common with Codri Plateau. Most pronounced differences pertain to the specificity of landscape of Codri Plateau, as shown in its name (Codri means Forest) is the most forested region of Bessarabia, while Ciulucurilor Hills is characterized by the predominance of steppe landscapes. The research was based on maps published in the late nineteenth century (1880), scale 1 : 126 000, a 1 : 200 000 Austrian-Hungarian map from the early twentieth century (1910), large-scale topographic maps of the second half of the twentieth century, Landsat satellite images in 2000. Relief and geological composition specificity was assessed based on field research, cartographic materials, while peculiarity of the soil was evaluated on the basis of bibliographic sources [4], [7],..., [9], field research, a 1 : 200 000 scale soil map and laboratory tests.

The purpose of research is to evaluate the main geocologic factors with possible influence on how the spatial distribution of forest and steppe landscapes.

3. Results and Discussion

In 1940s Natalia Dascalescu [2], in addition to the steppes plains and flooding area, singles out Codrii or Hills Forest in Bessarabia. Forests, in turn, by geographical location and floral composition are divided into Tour Codrii or Codrii Hotinului and Central Codrii with the following components: Codrii Nistrului, which is also called Codrii Orheiului or Codrii Mici, Codrii Bacului and Codrii Tigheciului.

With the above-mentioned in mind, we can conclude that the differentiation of the two major categories of natural units (forest and steppe) was carried out, proceeding from the relief characteristics. The hills and plateaus fit forest landscapes while plains are appropriate for steppes. Most of the authors explain the location of forest landscapes mainly in higher land areas by a higher annual average precipitation rate, which exceeds the annual average rainfall in the plain regions [2], [3], [7],..., [9]. The role of rainfall in the distribution of forests is not limited solely to providing optimum quantity of moisture to arborescent vegetation. Bigger rainfall also contributes to providing physico-chemical and structural changes in soils, especially in high porosity soils in which water has a greater penetration rate. Thus, water dissolves soluble salts (chlorides, sulphides, sodium salts, etc.), pushing them down sometimes to phreatic horizon. But penetration rate depends on size and porosity of the soil composition, characteristics largely determined by specific maternal rock. In most of the territory of the Republic of Moldova maternal rocks are represented by Neogene (clay, sand, gravel, limestone, etc.) and quaternary formations (loessoide deposits and loessuri, aleurite etc.). Sandy formations alternating

with clay and covered in some places with gravel with thicknesses up to 40-50 m are present mainly on the higher peaks of Codrii Bacului and Tigheci Hills (Prut - Ialpug interfluves). Sands with gravel can occasionally be found in regions further north, including the Dniester-Prut interfluve, and in the Raut-Prut interfluves, the boundary between Middle Prut Plain and Cubolta Plain. Highest peaks of the Dniester River Plateau (Băxani Hill, Vadeni Hill etc.), where until now natural forests have been preserved also consist of sandy deposits of basarabiană age, which, in some places, are covered by sand with gravel of younger age and thin strata of loessoide (Fig. 1).

Legend

Lithology






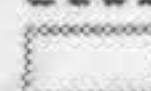
-  clays
-  clays with thin bed sand
-  clays and sand
-  limestones
-  gravel and sand
-  border of region



Fig. 1 – Hills Ciulucurilor. Geologic Map.

It is known that the Neogene rocks in the subsoil of Moldova as a whole are rich in salts. According to [2] "... forest vegetation could not spread into neither the steppe nor the lower Bugeac of Balti region because orographic situation and rainfall shortage prevented the release of soluble salts, especially NaCl , Na_2CO_3 , Na_2SO_4 so hazardous to forest" (p. 16) from soil and subsoil. But Ciulucurilor Hills does not fit this concept. Some hills in the region exceed the height of 320...340 m (Rădoaia Hill – 339 m, Rediul Hill – 349 m, etc.). According to most of the authors, the landscape of the Ciulucurilor Hills can be described as steppe, but this contradicts the higher land nature of its relief, and the relatively greater amount of precipitation, compared with regions of flat terrain in the north. According to digital cartographic models developed on the basis of multiple correlations, the average annual amount of precipitation on the highest peaks of the Ciulucurilor Hills exceeds 600...630 mm, sufficient for the

development of forest landscapes. It is necessary to note that there are some small areas of forests, such as hills Rădoaia, Rediul, etc. on the highest peaks of the Ciulucurilor Hills (Fig. 1). Most oak forest areas are currently found in the Soloneț river basin. A comparative analysis of digital models, geological maps, soil and ways of natural forests distribution shows that some pockets of natural forests are still present on the clay-sand deposits of basarabiană age, sometimes covered with alluvial deposits, which formed typical gray and soft soils, clay - iluviale black soils [4], [7]. As for Ciulucurilor Hills in many cases when the relief altitude exceeds 300 m and annual precipitation amount surpasses 600 mm forest landscapes are missing today and, judging from the specificity of soil, they didn't exist in the past. These ridges are covered by steppe landscape that is developing on chernoziom.

Steppe landscape dominance in the Ciulucurilor hills can be explained, in our concept, through specific geological composition, primarily that of maternal rock lithology.

Topography and contemporary landscape of the majority of Ciulucurilor hills ridges was formed on relatively homogeneous substratum of basarabiană age clays (Middle Sarmatian) with an noticeable content of salts, including gypsum. On some hills, at altitudes of 310...320 m, clays are covered with sand, which alternate with thin layers of clay of the same age as the underlying clays. Sands with clay, in turn, have the roof with sand gravel deposits of medium Pliocene age (Figs. 2 and 3). In case of Rădoaia Hill (elevation 335 m), maternal rock consists of basarabiene limestone. Under oak, hornbeam, maple and other vegetation, leachate clay Greyzems formed on the limestone.

Legend

— rivers
 ■ forests

Digital Elavation Model

Value
 ■ High : 351
 ■ Low : 0

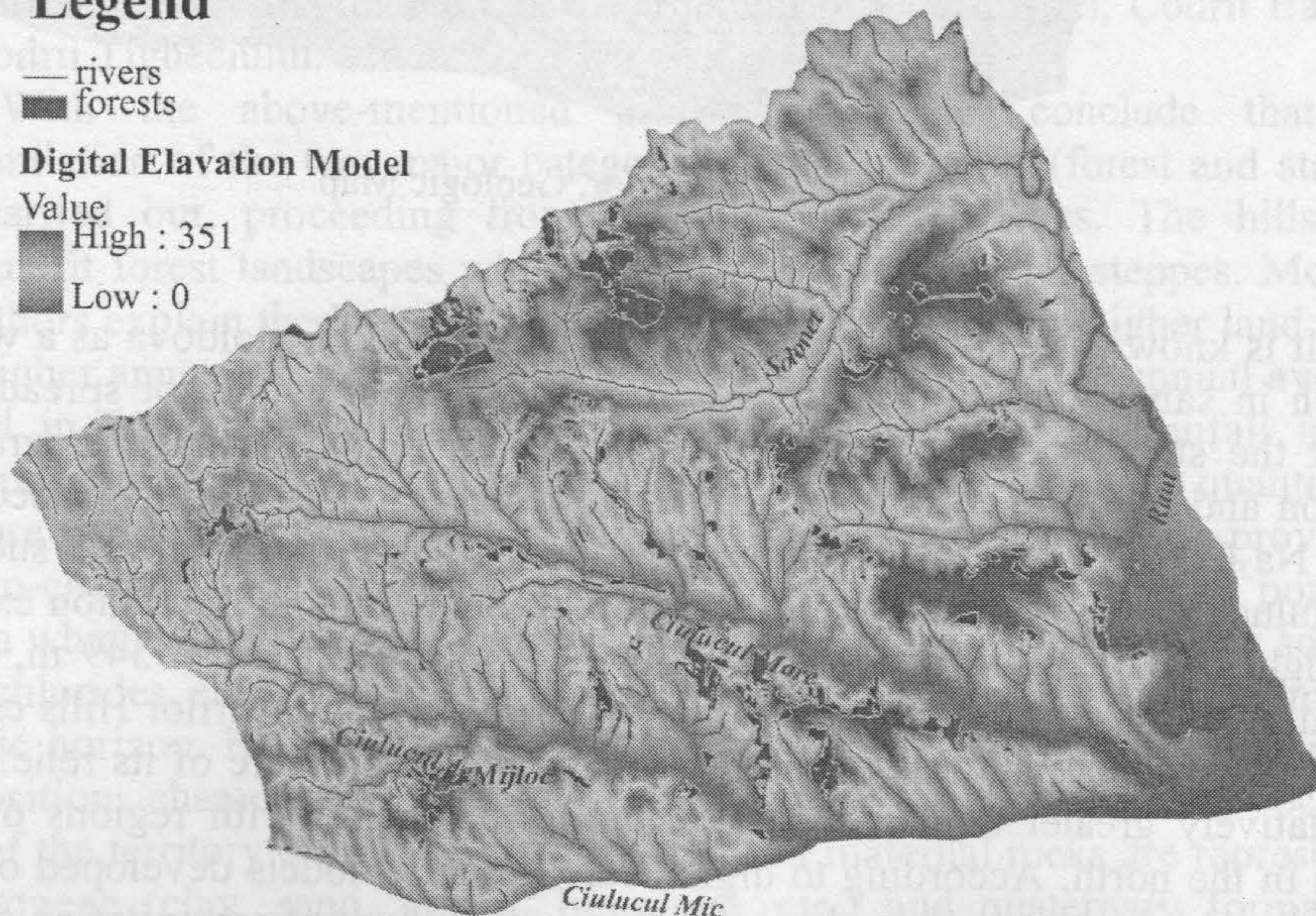


Fig. 2 – Hills Ciulucurilor. Distribution of Forests.

Thus, the availability of limestone (Rădoaia Hill), sands with sandstone

(Rediul Hill etc.) and relatively sufficient moisture (up to 630 mm) of annual average precipitation have created the optimal conditions for forest vegetation development.

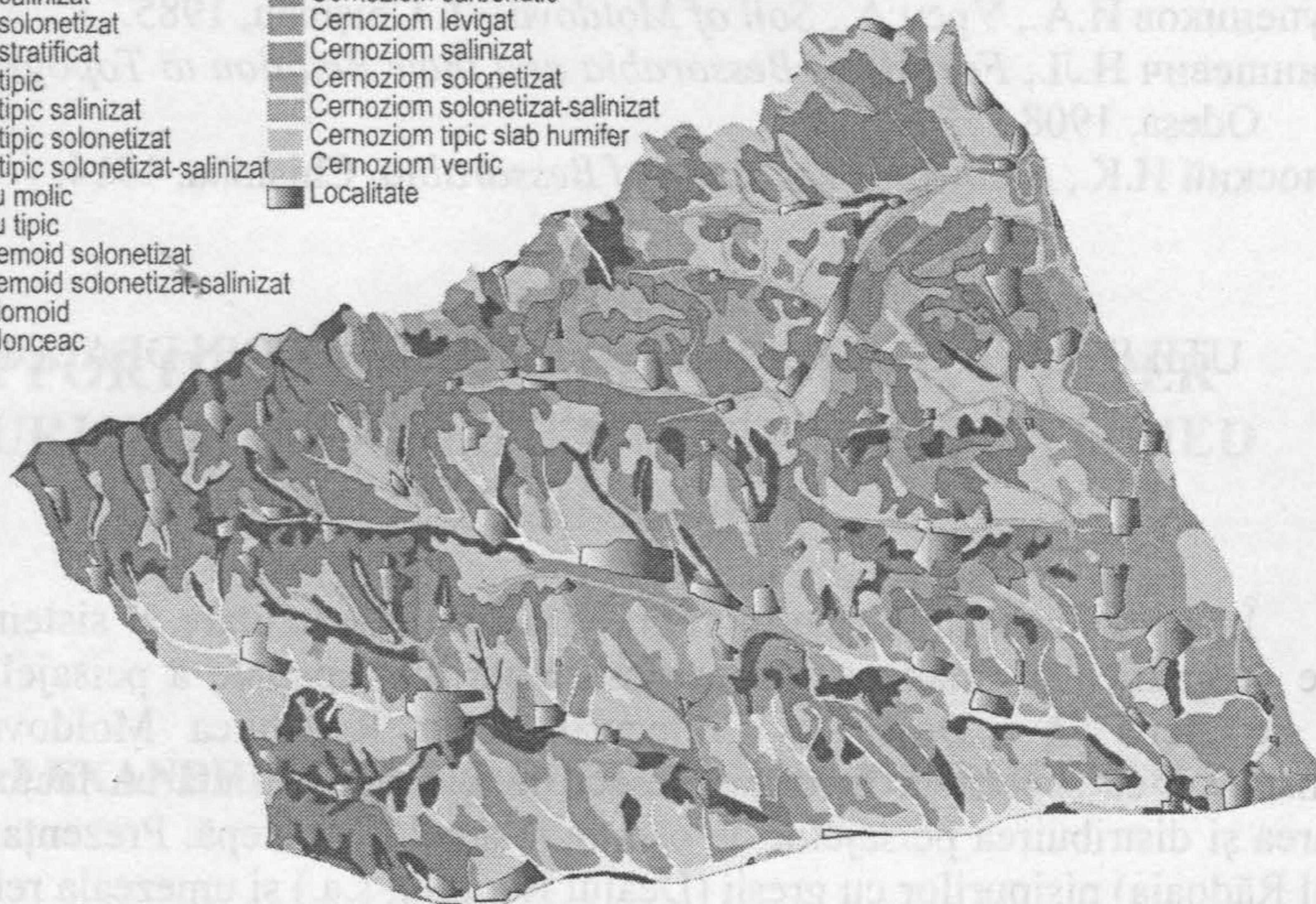


Fig. 3 – Hills Ciulucurilor. Map of Soils.

4. Conclusions

The presence of maternal sandy rock, the limestone and other permeable sediments, and a landscape of plateaus, contributes to the downward free flow of water, which causes salt dissolution and its washing out of the soil and underlying rock. Under the conditions when soil is formed on clay, impermeable rock, with a high content of salts, such as, for example, if most of the territory of Ciulucurilor Hills and Cubolta plain, steppe vegetation is being developed under which typical Chernozems, Solonetz, Chernozems Solonetzic, Saline Chernozems (Fig. 3).

Received: September 15, 2009

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UTILIZAREA SIG IN ANALIZA PEISAJELOR DIN DEALURILE CIULUCURILOR

(Rezumat)

În baza materialelor cartografice, imaginilor satelitare și sistemelor informaționale geografice se analizează specificul repartiției spațiale a peisajelor silvice și a celor de stepă în Dealurile Ciulucurilor din Republica Moldova. Cercetările demonstrează că specificul litologic al rocii materne reprezintă un factor important în formarea și distribuția peisajelor de pădure și a celor de stepă. Prezența calcarelor (pe Dealul Rădoaia) nisipurilor cu gresii (Dealul Rediului ș.a.) și umezeala relativ suficientă (până la 630 mm media anuală de precipitații) au determinat apariția condițiilor optime pentru dezvoltarea vegetației silvice. Pe rocile materne argiloase, bogate în săruri, se dezvoltă de pădure de stepă.