Lucrările Seminarului Geografic Dimitrie Cantemir
Vol. 42, October 2016, pp. 29-38
http://dx.doi.org/10.15551/lsgdc.v42i0.03

Forests ecosystems from the upper basin of Moldova and surroundings

Mihai Cătălin Mihăilescu[1], Nicu Ilie[1]

[1]Faculty of Geography and Geology, "Alexandru Ioan Cuza" University of Iaşi, Romania

To cite this article: Mihăilescu, M. C., Ilie, N. (2016). Forests ecosystems from the upper basin of Moldova and surroundings. *Lucrările Seminarului Geografic Dimitrie Cantemir*, Vol. 42, pp. 29-38. DOI: 10.15551/lsgdc.v42i0.03

To link to this article: http://dx.doi.org/10.15551/lsgdc.v42i0.03

ISSN: 1222-989X www.seminarcantemir.uaic.ro

FORESTS ECOSYSTEMS FROM THE UPPER BASIN OF MOLDOVA AND SURROUNDINGS

Mihăilescu Mihai Cătălin[1], Ilie Nicu[2]

Abstract: In the upper basin of Moldova and its surroundings there are many forest ecosystems generally composed of coniferous species (spruce, fir) and mixtures of these species, especially with beech. In this paper, I selected and described a total of 20 specific ecosystems from area and their ecologically determinant factors . We created charts favorability using pairs of two environmental factors: altitude-relief, temperature - precipitation, temperature - evapotranspiration, evapotranspiration - precipitation, humidity - relief, altitude - soil, that could describe the spectrum of ecological types of forest ecosystems in the study area.

Keywords: forest ecosystems, ecological factors, diagrams favorability, ecological specttre

Introduction

The forest is an environment that supports life. In a forest,the ecosystem populations and the trophic networks which they form, determine the structure of biota.The regime of ecological factors that influence the biocoenosis and in turn are modified by biota form the structure biotope. Autotrophic organisms from biota, produce organic matter using biotope factors and consumers convert all through biotope factors. Decomposers made available at the biotope, the necessary nutrients.

According to Doniţă N. and al. (1977), the criteria for the classification of forest ecosystems are: biocenotic criteria (edifying populations of trees, populations of biotope indicator plants, the main decomposers) biocenotic - biotope criteria (such as humus) and biotope criteria (the air and soil type regim).

The forest types and sites were described especially at the country level and not by region (Paşcovschi and Leander 1958 Purcelean and Paşcovschi 1968 Chirita et al. 1964 Chirita et al., 1977). Due to the high variability of living conditions (climate, relief, soils, rocks), which cause a pronounced regional diversity of forest ecosystems and sites, regional typological researches were attempted. The Institute of Forest Research and Management (ICAS), has developed a regionalization of forests production by Giurgiu et al. (1968). An ecological area of forests by Doniţă N., and all. (1980) highlighted the difference in yearly precipitation, between the western and the eastern slope of the Eastern Carpathians. The inventories of sites types for certain districts, were made by Chirită C., between 1970-1982. In 2006, dr. Geambasu N., from ICAS started researching the regional ecosystems and forest

[1] "Al.I.Cuza" University of Iasi, Faculty of Geography and Geology, Department of Geography, Bd.Carol I 20A, 700505, Iasi, Romania cata7823@yahoo.com

sites, but after his death, the project was stopped. By anthropogenic action, aridity, pollution, changes occur in the sites and forest ecosystems, which is why the regional typology research has a great importance for their sustainable development.The study of the area by *Barbu N.,1976*, describing vegetation in Bukovina Hills Sites, respectively by*C. Rusu, 2002*, describing the vegetation from Rarău Massive and the study of Silver fir ecosistems in Romania, conducted by *Barbu I., Barbu C., 2005*, are also very important.

Methodology

The main forest ecosystems in the area are spruce forests, mixtures of spruce-fir, spruce-fir-mixtures with beech and pure fir forests. According to Doniţă et al.1991, every type of ecosystem presents: code, name, type of associated plant, forest type, site type, site conditions and biota. Very important are indicator species that are sensitive to environmental conditions. For charting, we correlated ecological parameters in order to achieve an average of ecological niches of existing forest types in the study area. We use *the diamant sign*, for pure spruce forest, *the squares sign*, for pure fir forests, *the circle sign*, for mixed spruce and fir forests, the triangles, for spruce-fir with beech mixed forest and square with star, for mixed spruce-beech forest.

Code	**Type of ecosistems**
1136	Subalpine pure spruce forests ecosystems, weak productive, with moder, on brown soils, feri-iluvial, oligo-mezobasic, balanced moisture regim, with Oxalix-Soldanella.
1157	Subalpine pure spruce forests ecosystems, weak productiv, with raw humus - peat on podzols and brown-acid criptospodice, oligobazice and extremly oligobazic, balanced moisture regim, with Vaccinium - Hylocomium.
1218	Pure spruce forests ecosystems,high and middle productive with hydromorphic mull, on brown soils and brown acid soils, gleyed, meso and oligomezobazic, excess moisture in depth, with Myosotis.
1226	Pure spruce forests ecosystems, highly productive, with mull-moder, on acid brown soils and andic soils, oligomezobazic, balanced moisture regim, with Oxalis - Dentaria - Asperula.
1227	Pure spruce forests ecosystems, middle productive, with moder-mull, on alluvial soils, mesobasic, optimum moisture regim, with herbaceous layer dominated by Chrysantheum rotundifolium.
1237	Pure spruce forests ecosystems, middle productive with moder, on brown acid soils, brown feriiluviale, oligobazice, optimum moisture regim, with Luzula sylvatica.
1247	Pure spruce forests ecosystems, with moder-humus, brown soils, feriiluvial, eu-mezobazic to oligo-mezobaic,water optimum, with Hylocomium.
1256	Pure spruce forests ecosystems,weak productive with humus, on podzols, and brown feriluvial, oligobazic and extreme oligobazic, balanced moisture regim, with Vaccinium.
1268	Pure spruce forests ecosystems,slightly productive, with gross humus, and peat on brown soils, brown feriiluvial, podzols gley-peat oligobazic, moisture surpluse in-depth, Polytrichum
2116	Silver fir ecosystems, high and medium productive, with mull (mull - moder), on brown and luvic soils, eu - and mezobasic, balanced hidric, with Oxalis - Dentaria - Asperula.
2118	Silver fir ecosystems, high productive, with forest mull, on brown soils, brown acid luvic soils, gleyed soils, eu - oligomezobazic, excess of moisture in depth, with Oxalis Pleurozium.
2216	Mixed forest ecosystems of fir-spruce, high and middle productive with mull (mull-moder), on brown soils, brown luvic soils, eu-mezobazic and acid brown mezobasic soils, balanced moisture regim, with Oxalis - Dentaria - Asperula.
2228	Mixed forest ecosystems of fir- spruce, highly productive with moder mull on brown soils, brown luvic soils, acid brown soils, feriiluviale brown soils, gleyed, mezzo and oligo-mezobazic, water in excess in depth, with Oxalis Pleurozium.
2236	Mixed forest ecosystems of fir- spruce, middle productive with moder humus on acid brown soils, feriiluvial brown acid soils, cryptospodic soils, oligo-mezobasic, water balanced regim, with Calamagrostis-Luzula.
2237	Mixed forest ecosystems of fir- spruce, middle productive, with moder, on brown acid soils, brown feriiluvial soils oligobasic, water balanced regim, with Luzula-Sylvatica.

2316	Mixed forest ecosystems of spruce - fir and beech, high and middle productive, with mull (mull moder), on brown soils, typical soils, rendzinic and luvic soils, eu-mesobasic or feriiluvial brown soils, oligo mezobasic, water balanced, with Oxalis - Dentaria - Asperula.
2318	Mixed forest ecosystems of spruce - fir and beech, high and middle productive, with hydromorphic mull, on brown soils luvic soils,eu-mesobasic, brown acid soils, brown feriiluvial soils and luvisoils, oligomezobazic, excess of moisture in depth, with Myosotis.
2327	Mixed forest ecosystems of spruce - fir and beech, highly and middle productive with mull-moder on acid brown soils, brown soils and brown acid feriiluvial soils, criptospodic acid brown soils, oligomezobasic, water optimal supply, with Rubus Hirtus.
2344	Mixed forest ecosystems of spruce - fir and beech, weak productive, with moderate gross humus, brown soils, brown acid feriiluvial soils and criptospodic acid brown soils, oligo-mezobasic, water ballanced, with Calamagrostis-Luzula.
3244	Spruce breech stands, weak productive, with moder raw humus, brown soils, brown acid feriiluvial soils and criptospodic soils, oligomezobazic, water cvasiechilibrate,with Calamagrostis-Luzula.

Table 1. The main types of forest ecosystems in the upper basin of Moldova and surroundings

1. Average altitude and relief

To achieve ecological altitudinal spectrum depending on relief, I divided relief into 7 classes according to Table 2:

Table 2. The main relief forms and appropriate class for forest ecosystems in the study area

Clases	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Relief	Peak	Ridge	Superior versant	Middle Versant	Inferior versant	Terrace	Valley

We can classify spruce forests **(*diamonds*** fig. 1), after altitude and landforms which they occupy in the upper basin of Moldova and do this:

- spruce ecosystems on terraces and valleys, at altitudes between 800 - 1700 m (1218, 1227, 1268);
- spruce ecosystem on lower slopes and terraces, (1247), at altitudes between 1000-1300 m;
- Spruce ecosystems present on the lower or medium slopes (1226), at altitudes between 1000 and 1300 m, respectively (1237) 1300 1600 m;
- spruce ecosystems on middle and upper slopes, respectively on the peak (1136), at altitudes between 1300-1600 m;
- spruce ecosystems on upgrades (1257), pinnacles and ridges (1256), at altitudes between 1300-1800 m.

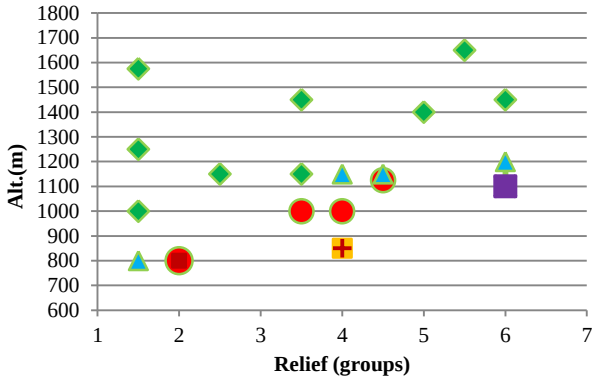

Fig.1. Ecological spectrum determined by altitude and position on the slope, depending on the relief, occupied by forest ecosystems in the upper basin of Moldova and surroundings

In the studied area we spotted two types of pure silver fir (***plus sign*** fig. 1), occupying from the lower slopes and terraces (2118) to medium-upper slopes (2116), altitudes between 600 and 1200 m.

The mixtures of conifers species, spruce-fir (***red circle***), is the second type of ecosystem in terms of spread within the study area:

- Mixtures of spruce with fir (type 2228), on valleys and terraced, at altitudes between 600-1000m.
- Mixtures of spruce with fir (type 2216), on lower and medium slopes, at altitudes between 800-1200 m.
- Mixtures of spruce - fir (2237), on all the slopes and at elevations between 800-1200 m.
- Mixtures of spruce - fir, (2236) on the slopes and ridges, at altitudes between 900-1350 m.

Mixtures of 3 species, spruce - fir - beech (***tringle***) are encountered on landforms ranging from valleys and terraces (type 2318) on hillsides middle and senior (2316; 2327), ridges and rises to 1250 -1350 m (2344).

One mixed spruce and beech ecosystem (3244), is better represented in the study area, (***star***), with positioning on higher versant, 1000 m peaks and ridges from 1200 m altitude. *Figure 1.*

2. Rainfall (mm) and temperature (^{o}C), multianual average

Generally, when rainfall decreases, temperature increases. Spruce forests are installed in areas with the lowest average temperatures. They fall between 4.5^{o}C (when the average of precipitation is 850 mm), type 1218 and 2^{o}C (when the average of precipitation is 900 mm), type 1157, or 2.3^{o}C (when the average of precipitation is 1100 mm).

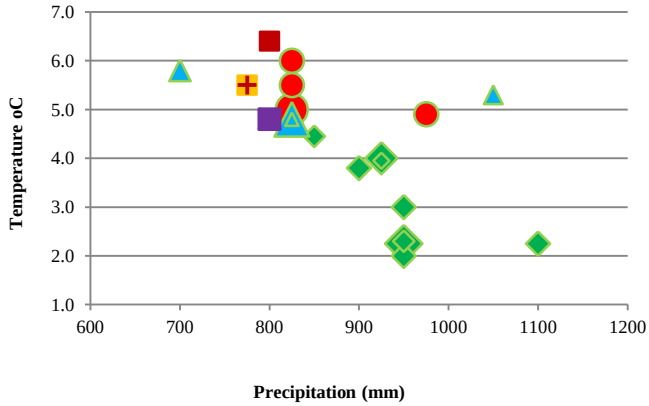

Fig. 2 Ecological spectrum determined by temperature, depending on rainfall, occupied by forest ecosystems in the upper basin of Moldova and surroundings

The fir ecosystems from the study area, have the average of temperatures of 5.5^{o}C, when the average annual rainfall amounts are 775 mm, type 2116, respectively 6.4^{o}C when the average annual rainfall amounts measured values close to 800 mm, type 2118. *In the resinous mixtures*, the average of temperatures range between 4.9^{o}C, when the average annual rainfall amount is close to 975 mm, type 2236 and 6.0^{o}C on average rainfall of 825 mm, type 2237. *The coniferous and beech ecosystems* are colder than spruce fir ecosystems, 4.8^{o} C,

types 2316 and 2327, when the average annual rainfall amounts are 825 mm. When the average of temperature is 5.3°C, the average annual rainfall increases to 1050 mm (type 2344). At 5.8°C, the average annual rainfall drops to 700 mm, characteristic of type 2318. Ecological spectrum in *mixture spruce and beech ecosystem*, type 3244, is characterized by a mean temperature of 4.8°C and an average rainfall of 800 mm (figure 2).

3. Temperature and potential evapotranspiration (ETP), multianual average

At low temperatures, evapotranspiration is the lowest. *Spruce ecosystems* present a spectrum of temperatures and ETP ranging from 2.0°C, when the average annual EPT is 387.5 mm (type1157) to 4.5°C, when the annual average of EPT is 500 mm (type 1218). The minimum ETP, 350 mm, is at 2.3° C in 1227 type. *Figure 3*

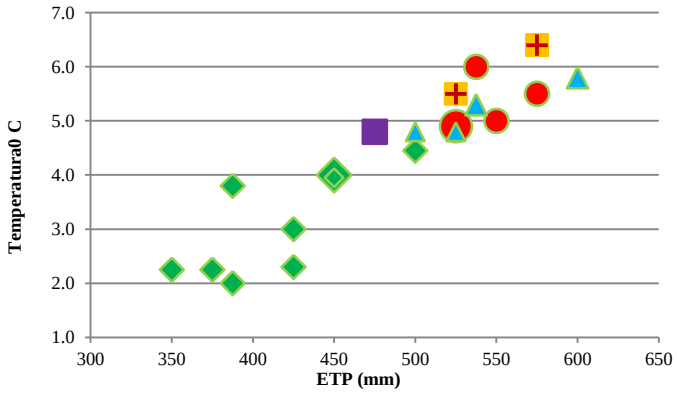

Fig. 3 The ecological spectrum determined by temperature, depending of evapotranspiration occupied by forest ecosystems in the upper basin of Moldova and surroundings .

The fir forest ecosystems present an ecological spectrum characterized by temperatures between 5.5°C at 525 mm ETP, type 2116, to temperatures of 6.4°C at 575 mm ETP, type 2118, the highest average temperature of all ecosystems under study.

At spruce-fir mixture, type 2237, the highest average of temperatures is 6°C, when the anuall average of EPT is 538 mm. The type 2236, has the lowest average of temperature 4.9°C, at anuall average of ETP 525 mm, *Figure 3*.

The mixed of *coniferous species with beech*, 2316, shows an average temperature of 4.8°C, over the spruce pure forests, but the lowest average from all mixtures, to an average of 525 mm EPT. Type 2318 have an average of temperature 5.8°C at an average of 600 mm ETP.

The spruce-beech ecosystem, type 2344, has a temperature of 4.8°C to an average of ETP 475 mm. *Figure 3*.

4. Average of precipitation and real evapotranspiration (ETP)

In areas with spruce forests is present the lowest average ETP and the highest average rainfall. The *spruce stands* have the lowest average of ETP and the highest average of rainfall. Type 1227, for example, has precipitation of 1100 mm and 350 mm of ETP. The lowest value of precipitation for a spruce ecosystem is 850 mm at ETP 500 mm.This is the highest ETP value, that we meet in the 1218 type. *Figure 4*

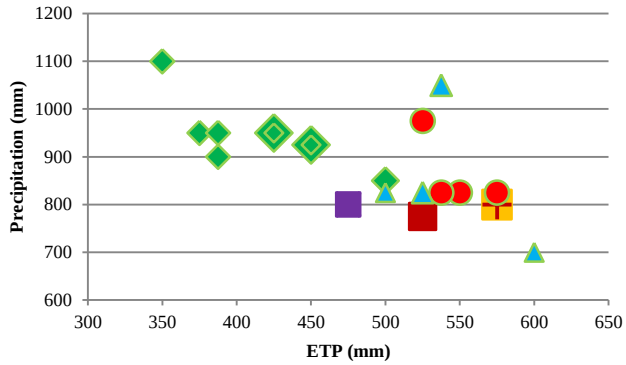

Fig. 4 The ecological spectrum determined by precipitation, depending of evapotranspiration occupied by forest ecosystems in the upper basin of Moldova and surroundings .

In *pure fir ecosystem* (2116), the average rainfall are the lowest (775 mm) and also the lowest average of evapotranspiration, 525 mm, *figure 4*. In the 2118 ecosystem type , the average of rainfall is 800 mm, with an evapotranspiration average 575 mm.

The mixed spruce-fir ecosystem, type 2236, have a value of rainfall of 975 mm, with an evapotranspiration of 525 mm. In the studied area there are 3 types of mixed spruce fir ecosystems, characterized by the same average rainfall (825 mm), but with different evapotranspiration: 538 mm, 550 mm and 575 mm, the last among the highest of ecosystems under study.

The mixture of coniferous species with beech, 2344, presents the second average of precipitation 1050 mm, at an average of evapotranspiration of 538 mm. At the other extreme is a type 2318, with rainfall of 700 mm (the lowest), but evapotranspiration 600 mm, the highest average of all ecosystems analyzed.The last type, 3244, the spruce-beech ecosystem, has an average rainfall of 800 mm at a 475 mm evapotranspiration. This is the most common type of molideto-beech forests. *Figure 4*

5. Average of spring and summer soil humidity (vernal and estival soil moisture)

Soil moisture can be evaluated using stairs of momentary moisture**.** Depending on the condition of soil saturation with water at a time, they were awarded the following steps of moisture (momentary degrees), which recognizes organoleptic on field, using a soil sample which is grated in hand (Chirita et al, 1977) *table 3 and 4*

Table 3 Momentary stairs moisture

Steps	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Soil Humidity	Dry	Dry-wet	Wet	Wet-moist	Moist	Moist - damp	Damp	Damp - wet	Wet	Partially submerged

We note that at *spruce pure ecosystems*, average vernal moisture (Uv) is lower on medium and lower slopes 2.5 (type1226) and in the valleys, but also on some terraces, Uv reach highs value: 4.5 (type1227) 6.5 (type1218) and 8 (type 1268). The ecosystem on ridge level has Uv 3.5, (type 1256).

In *fir pure ecosystems*, which occupy generally medium slopes (type 2116), and lower terraces or slopes (type 2118), moisture is 3.5 and 8. *At the mixed spruce fir ecosystems*, vernal moisture falls from 8 in high valleys, terraces and inferiors slopes, where there is the type of ecosystem (2228) to 3.5 on the medium and superior slopes, with a kind of mixture on the middle slope (type 2237), with 5.5 vernal moisture.

Table 4. The average moisture in spring (Uv) and summer (Ue), corresponding to relief steps and species of forest ecosystems from the study area

Ecos. type	1136	1157	1218	1226	1227	1237	1247	1256	1268	2116	2118	2216	2228	2236	2237	2316	2318	2327	2344	3244
Relief	5	5.5	1.5	3.5	1.5	3.5	2.5	6	1.5	4	2	3.5	2	4.5	4	4	1.5	4.5	6	6
Average Uv	3.5	3.5	6.5	2.5	4.5	5.5	4.5	3.5	8	3.5	8	3.5	8	3.5	5.5	3.5	8	4.5	2.5	2.5
Average Ue	3	4.5	4.5	3.5	3.5	4.5	4	2.5	5.5	2.5	5.5	3	5.5	3	4.5	3	5.5	3.5	1.5	3.5
Species	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Mo	Br	Br	MoBr	MoBr	MoBr	MoBr	MoBrFa	MoBrFa	MoBrFa	MoBrFa	MoFa

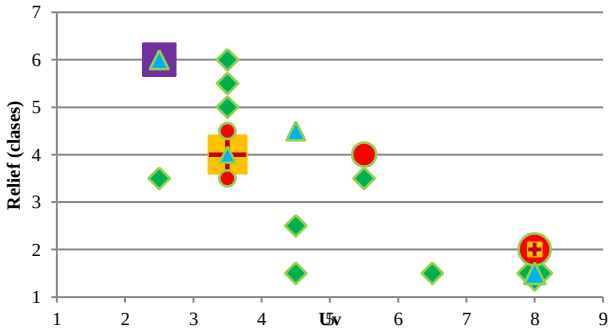

Fig. 5 The ecological spectrum determined by relief, depending on the vernal humidity Uv, in forest ecosystems in the upper basin of Moldova and surroundings

Mixed ecosystems with spruce-fir-beech, fall from the valleys and terraces (type 2318), where moisture is high 8, to level higher, even ridges (type 2344), where it drops to 2.5.

Mixed ecosystems of spruce and beech, characteristic to higher landforms, (higher slope and ridge), have Uv 2.5, *Figure 5.*

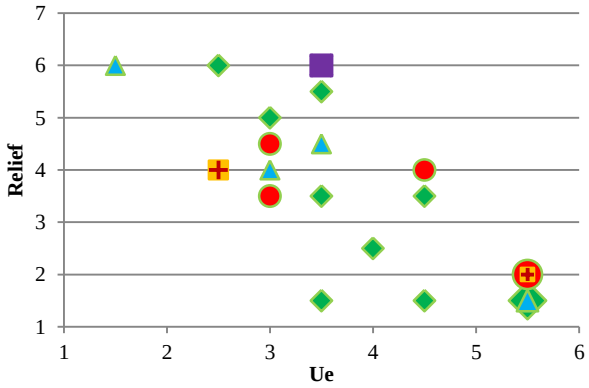

Fig.6 The ecological spectrum determined by relief, depending the summer humidity in forest ecosystems from the upper basin of Moldova and surroundings

We note that at spruce forest ecosystems, summer humidity (Ue) are lower on higher slopes and ridges 2.5 (type 1256). Here there are encountered less productive spruce forests.In the valleys, terraces, average of Ue reach the following values: 3.5 characteristic for

type 1227, 4.5 in middle and high productive spruce forests (type 1218) and 5.5 at a spruce forest ecosystem with weak production (type 1268). At spruce forest ecosystems from high altitude (type 1157), summer humidity is on average 3.5. *figure 6*

In pure fir forest ecosystems, which generally occupy the lower slopes, medium and terraces, average of summer humidity is 2.5 (type 2116) and 5.5 (type 2118). Productivity is high and medium.

At the mixed spruce-fir forest ecosystems, summer humidity is reduced from 5.5 (type 2228) in the valleys, high terraces and inferior slopes, to 3.0 on the medium and superior slopes (2236), with a kind of mixed forests on the middle slope where summer humidity is 4.5 (2237). Mixed of spruce, fir and beech forests ecosystems, show high value of summer humidity in the valleys and terraces 5.5, but at higher versant, even ridges, this drops to 1.5 (2344). Type of ecosystem 2316, is the most common mixture of spruce - fir-beech, and has summer humidity 3.Mixed spruce and beech forests ecosystems, weak productive, met at the higher landforms has summer humidity (Ue) higher in the spring (3.5).

6. Soils

There are several types of soil in the area, from which we selected only one specific type of soil, in order to achieve an example of the ecological spectrum. *Table 5*

Tabel 5. Soil type and code given to the 20 forest ecosystems to achieve ecological spectrum caused by altitude

Tipe of soil	**Brown soils**	**podzol**	**Brown soils**	**Acid Brun**	**Alluvial soils**	**Brown feriiluvial**	**Brown feriiluvial**	**podzol**	**Brown feriiluvial**	**Brown soils**
Code	1	2	1	3	6	7	7	2	7	1
Tipe of soil	**Brown soils**	**Brown soils**	**Brown soils**	**Acid brown**	**Acid brown**	**Brown soils**	**Brown soils**	**Acid Brown**	**Brown feriiluvial**	**Brown feriiluvial**
Code	1	1	1	3	3	1	1	3	7	7

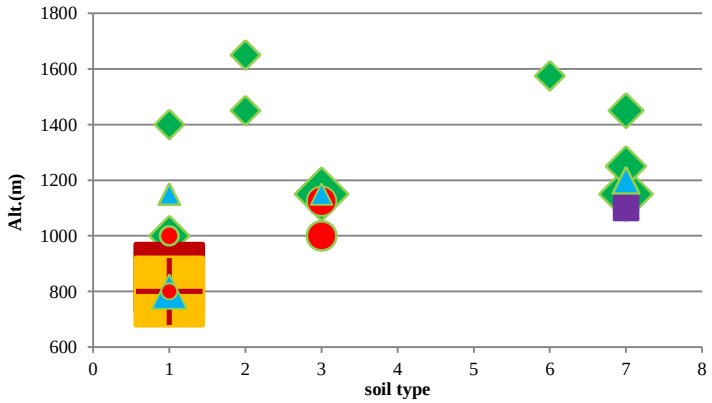

Fig. 7 The ecological spectrum determined by relief, depending on the type of soil in forest ecosystems from the upper basin of Moldova and surroundings

Spruce forests ecosistems, which occupy an average altitude above 1000 m, has brown soils, podzols (pure class specific soil spruce fir), alluvial and brown feriiluvial soils. *Pure fir forests ecosystems*, vegetate on brown soils, at elevations below 1000 m. *Mixed spruce - fir forests*, presents brown soils at 800-1000 m and acid brown soils at an altitude of 1000 -1125 m. *Mixed of spruce - fir-beech*, vegetate on brown soils, brown acid and brown feriiluvial soils at medium altitudes of 1000-1200 m. Spruce - beech forests have average altitude of 1100 m and vegetate on feri-iluvial brown soils *figure 7*.

7. Productivity

It is the ability of the forest to produce biomass. Class I and II are considered superior; class III middle; class IV and V lower grades (low productivity and weak productivity) *Iancu I. 1982.*Productivity is performed during multiannual vegetation periods that are made under the most favorable temperature and humidity in the close atmosphere and soil. Depending on the productivity of the studied ecosystems, we appreciated average values of height, diameter and volume per hectar, achieved at the age of 100 years (according to Doniţă N., 1991)

Table 6 The types of forest ecosystems in the studied area and classes for productivity

Ecos. type	1136	1157	1218	1226	1227	1237	1247	1256	1268	2116
Productivity	III-IV (V)	V	I-III	I-III	(II)III-IV	II-IV III	II-III	IV-V	III-IV	I-III
Ecos. type	2118	2216	2228	2236	2237	2316	2318	2327	2344	3244
Productivity	II-IIIFi	I-II-IIISpFi,III-IVBe	I-II SpFi,IV-VBe	II-IIISpFi	II-IIISpFi	I-IISpFi II-IIIBe	I-IIISpFi,II-IIIBe	II-IIISpFi,IIIBe	III-IVSpFi,IV-VBe	(III)IVVSpBe

At the *pure spruce forests* (*firsts nine from the table 6*), predominate class III (middle) of production. There is a limited spruce forests ecosystem (type 1136), which is weak productive, with an average height of 21 m, diameter 28 cm and an average volume of 302 m^3 / ha. Spruce forests ecosystem weak productive (type1256), with production class V or IV-V, reaches an average height of 20 m, diameter 27 cm and a volume of 250 m3 / ha. In type 1218, 100 years old, average height is 31.5m, diameter 39 cm and an average volume of 665m^3/ha. It is an ecosystem with superior production classes. In type 1226, characterized by highly productive soils rich in humus, average height is 25 m, average diameter 42.5, with an average volume of 730 m3 / ha.

Pure fir forests ecosystems, type 2116, has class I of production, achieved heights of 31.5 m, a diameter of 41.5 cm and a volume of 723m^3 / ha.

Pure fir forests ecosystems, type 2118, are typical of the production classes II and III, and achieve 29 m height, diameter of 38 cm and an average of volume 530m^3 / ha.

Type 2216, *mixed spruce and fir forest ecosystems*, has high productivity, wood quality, with heights from 35 m in spruce to 32 m in fir, spruce average diameter 42 cm and fir diameter 41 cm, with an average volume of 690m^3 / ha. Beech which appears in the mixtures, is placed in classes IV and V, with defective forms. Type 2228 with superior productivity for both softwoods, presents good quality wood and achieves heights of 32 m in spruce to 31 m in fir, diameter 39 cm and a volume of 640m^3 / ha. Types 2236, 2237, medium productive, have specific classes: II and III.They consist of trees with an average height between 28 m in spruce to 27 m in fir, spruce diameter of 36 cm and fir diameter 34 cm, with an average volume 530 m^3 / ha, in type 2237.

For type 2316, production class is superior *for conifers species and a medium class for beech*. Highly productive spruce presents the 100 years the height between 31-36 m, 40-43 m diameter and an volume per year from 520-670 m^3 / ha. Production class of the type 2318 is superior for coniferous species, which present right wood. Sometimes beech trees have defective forms at class II-III of production.The presence of large skeleton in the ground makes type 2327 to provide classes II and III, for spruce and fir trees, respectively III class for beech, where wood defects occur.Average volume to 100 years at the 3 species is between 405-540 m3 / ha. Ecosystem type 2344 is slightly productive and presents production classes III and IV to spruce and fir, namely class V for beech. At 100 years, the average diameter is 32 cm in spruce and fir, respectively 22.5 cm in beech.The height average is: 26 m, in spruce, 21m in fir and 25 m in beech.

Spruce-Beech ecosystem, present at type 3244, has middle to lower productivity on spruce (III, IV, V) with the achievement at 100 years of 22 m height, 29 cm diameter and an average volume of 282.5 m3 / ha. Beech trees, which usually appear faulty trunks average height is 20 m, diameter 22 cm and productivity V.

Conclusions

In terms of altitude, forest ecosystems in the studied area are between 600 and 1800 m, covering almost all forms of relief, from valley to terraces, and all grades of slope up to the high ridges. In some ecosystems limit, there is a frail advancement of spruce, which on housed slopes can climb to over 1700m, with a slow growth and deformation of the canopy.

Pure fir forests ecosystems are positioned altitudinal lowest, and some mixed coniferous and beech occupy lower landforms.

When precipitation increases, the temperature drops, a phenomenon better seen in spruce forests ecosystems. The highest average temperatures are in pure fir forests and richest rainfall occurs in pure spruce forests.

At lower average of temperature, mean evapotranspiration (ETP) is low and spruce forests are predominant. Mixed ecosystems and pure fire forests ecosystems, present the highest average of temperatures and evapotranspiration. Relationship between precipitation and evapotranspiration (ETP), draws a slight increase of ETP, with decreasing rainfall.

Spring soil moisture (Uv), increases to all ecosystems, from the highlands to the valleys. Summer moisture follow the same course, driest soils belonging to ridges and superior slopes, populated by spruce and beech ecosystems and the wettest are terraces and valleys, where vegetate pure spruce populations, mixtures of species and pure fir populations. Brown soils more fertile and rich in humus, are deep, and are at an average altitude of 800 m. Mixed forest ecosystems are on the most fertile soils in comparison to spruce ecosystems.

The main limiting factors occurring in the ecosystems from studied area are: low edafic volume, low trophicity, temporary high humidity on plane surfaces, insufficient heat from the soil and air, low aeration, high acidity, high content of skeleton, cold and strong winds and strong frosts.

References

1. Barbu I., 2005. *Silver fir (Abies alba Mill.) în România*, Editura tehnică Silvică.
2. Barbu N., 1976. *Obcinile Bucovinei*, Ed. Stiinţifică ţi Enciclopedică, Bucureşti.
3. Chirită C., et al, 1977. *Staţiuni forestiere*, Ed. Academiei, Bucuresti.
4. Doniţă N., et al, 1977. *Ecologie forestieră*, Ed. Ceres.
5. Doniţă N., et al, 1991. *Tipuri de ecositemeforestiere din România*, Centrul de propaganda agricolă, Bucureşti, 1991
6. Doniţă N., et al, 2009. *Despre cataloage regionale de tipuri de ecosistemeşi de staţiuniforestiere,* RevistaPădurilor nr 6, 2009
7. Iancu I., et al, 1982. *Mică enciclopedie a pădurii*, Ed. Stiinţifică ţi Enciclopedică, Bucureşti.
8. Paşcovschi, S., Leandru,V., 1958. *Tipuri de pădure din Republica PopularăRomână*, EdituraAgrosilvică, Bucureşti.
9. Purcelean, S., Paşcovschi, S., 1968. *Cercetăritipologice de sintezăasupratipurilorfundamentale de pădure din România*, Centr. Doc. Tehn. pentru Econ. Forest.,Bucureşti, 106 pag.
10. Rusu C., 2002. *Masivul Rarău, Studiu de geografie fizică*, Ed. Academiei Române, Bucureşti.