RESEARCH ON 7135 FOREST ECOSYSTEM TYPE TURKEY OAK WITH *GENISTA - FESTUCA HETEROPHYLLA* (REGIONAL VERSION WITH *COMMON OAK* - SESSIL OAK - HUNGARIAN OAK MIXED STAND) WITHIN THE SEGMENT OF LANDSCAPE SITUATED ON HIGH PLAIN OF TINCA FOREST DISTRICT

Moţiu Petrică Tudor*

*University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea, Romania, e-mail: tudor_motiu@yahoo.com

Abstract

The identification and description of types of forest ecosystems on smaller geographical units, at the level of landscapes (lands haft), in order to establish the ecological specificity within a certain territorial unit and the establishment of some sustainable management measures, gives the forest typology a strong regional feature.

Key words: forest ecosystems, management measures, sustainable forestry, forest typology.

INTRODUCTION

The typological research using GIS tools is usefull in practical forestry, being the base for sustainable forestry. The variability of general conditions (climatic, geologic) is very high and this variability induces a high variability of forest types. Each geographical unit, either it is about zones – subzones, levels-sublevels, regions-provinces have distinct features which causes the existence of some inventory of types, with strong regional features.

Forest typology have a strong geographic features because different forest types cannot be determined solely on the large areas where the repetability of some biocoenosys is evident, determined according to some species which occupying a certain ecotop.

The aim of the study was to establish the types of forest ecosystems from the Low Plain of Crisul Negru river and to esteblish the state of these ecosystems in order to fiind the best management solution for a sustainable use but preserving and conservation of the optimum biodiversity of the forest. The aim of the research was also the scientific fundamentation very usefull both in forest management and in applied forestry in order also to fiind the best management solutions for a sustainable use.

STUDY AREA - PHYSICAL AND BIO-GEOGRAPHICAL CONDITIONS

High piemontan plain, situated in the center of the study area, with average altitudes of 100-200 m., with increasing values eastward, is a Pleistocene plain unit, largely folded, resulted from the connection of the alluvial cones of the river flowing from the mountains and hills situated eastward.

The connection between the plain and the hills is marked by a morphological threshold of about 40-60 m.

The provulial deposits from the plain are consisted of clay and silt deposits. On these materials heavy and alternant hydric soils forms.

The relief in dominantly a plateau, slightly folded and fragmented by some shallow, temporary brooks. The climate is warm, less humid as in the low hill unit (mean average temperatures of 10^{o}C, average rainfall quantities of 614.7 mm).

The clays (red clays) are the base of stagnic luvisols on the slopes, planic and whitish soils on the plateau, with a well balanced hydric regime.

Within these natural conditions the plateau ecosystem is consisted of turkey oak, peduncu late oak, sessile oak, hungarian oak, usually the mix of two even three species, with the presence of the common hornbeam along the small brooks. The soil indicators herbaceous and shrub layer is consisted of *Agrostis-Carex brizoides*, *Genista-Festuca heterophylla* on the plateaus, *Glechoma-Geum* and *Arum-Brachypodium* along the brooks.

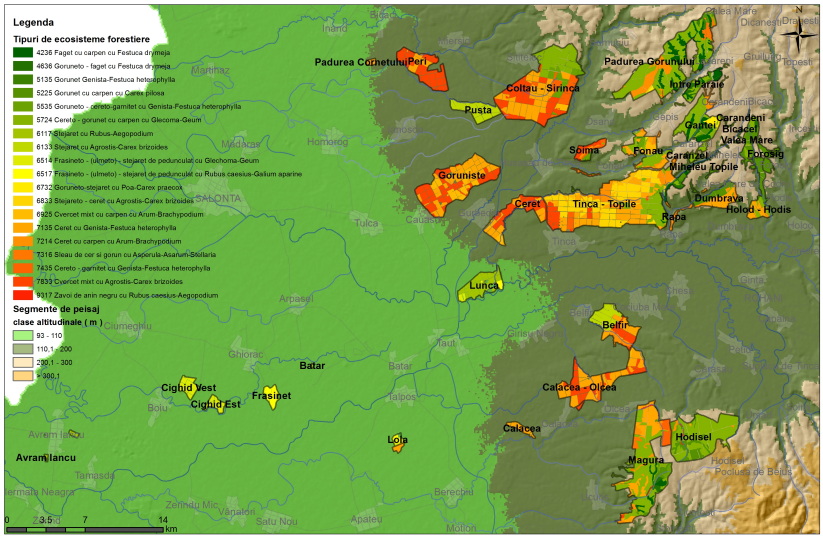


Fig. 1. The territorial repartition of the 7135 forest ecosystem type presenting the percentage within the composition of hornbeam trees

MATERIAL AND METHOD

The locations of the research are the forests administrated by Tinca Forest District; the study has started in 2018 and continued in 2019.

The description of the forest ecosystem was made based on collected field data. In order to analyse the collected data were used different softwares such as Excel, ArcGis.

The use of G.I.S. in the forestry is very important because it could supply a wide range of information upon which a sustainable use of the forest is possible, also offering the possibility of analyze and prognosis of different components of forest ecosystem as a whole. In this study we opted for the development of a geographic concept model.

The forest ecosystems were analysed according to location within the sudy area; the features of the ecosystem type: surface area, geographical paramaters (average altitude, altitude range); relief forms: types, inclination of the slopes, slope expozition, lithology, soil types ans subtypes, ecological limitative factors); the description of the stands, the description of the herbaceous layer; the correspondance with: types of forests, types of stations, plant associations, types of habitat, present state of the stands and management measures (particularities): main features, distribution accordin age classes, the source of main elements, natural regeneration, productivity classes, manegement measures, variability and succession tendency (forms of type, successional tendencies and forest facies).

RESULTS AND DISSCUSIONS

TYPE OF ECOSYSTEM: 7135 Turkey oak stand middle productive, with moder, on brown luvic soils and luvisoils, pseudogleyzation, oligomesobasics, well balanced from hydric point of view and alternating on profile, with *Genista-Festuca heterophylla* (the regional type with *common oak - sessil oak - hungarian oak* mixed stand)

Subtypes: 71351 highly productive subtype;
71352 mid productive subtype.

Spread: this ecosystem type is spread within the high plain and low hill units. Este reprezentat în U.P.I - Trup Ceret, Trup Goruniște, U.P.II - Trup Coltău-Șirinca, Trup Peri, Trup Pădurea Cornetului, U.P.III - Trup Fonău, U.P. IV - Trup Tinca - Topile, Trup Dumbrava, Trup Miheleu - Topile, U.P.V - Trup Măgura, Trup Călacea - Olcea.

The main features of the ecosystem type:

a. Surface: 2631,3 ha.

b. Forest sites:

- the average altitude is 185 m (variation difference 130-240 m);

- relief: by shape – mostly plain, partly slopes; based on inclination – no inclination or smooth and moderate slopes; based on exhibition – flat ground or slopes with different exhibitions, mostly sunny;
- rock: red clays, sand alternations, sandy clays;
- types and subtypes of soil: stagnic luvisols, white stagnic and flat stagnic;
- ecological limiting factors: compact soils on the Btw horizon, causing stagnogleization and reducing edaphic volume, humidity at the limit of the need for plants in the second half of the summer.

c. Compositions of the stands: in the dominant *Quercus cerris* level (in high proportions, sometimes exclusively); spread or to the extent of facies: *Quercus robur, Quercus petraea ssp. dalechampii, Quercus petraea ssp. polycarpa,* rar *Quercus frainetto,* in a few situations it may be encountered *Prunus avium*; on the dominant level may occur *Acer campestre, Acer tataricum, Pyrus piraster, Sorbus torminalis*, rarely *Carpinus betulus*, covering from 5% up to 10% of the surface.

d. Sub-tree compositions: *Crataegus monogyna, C. laevigata, C. pentagina* (rarely)*, Prunus spinosa, Ligustrum vulgare, Rosa canina, Rubus canescens, R. sulcatus;* it may also be encountered on a reduced frequency: *Cornus sanguinea, Sambucus nigra, Rhamus cathartica.*

The layer of shrubs is usually well developed, with a coveragre of 30% - 60% of the surface. In some cases, may be encountered within the sub-tree layer *Acer campestre, Acer tataricum, Carpinus betulus* and *Pyrus pyraster,* from the scattered species covering up to 5%, maximum 10% of the surface.

e. Composition of the herbaceous layer: *Festuca heterophylla, Genista tinctoria, Carex praecox, C. caryophyllea, C. divulsa, C. contigua, Veronica officinalis, Dactylis polygama, Lychnis coronaria, Calamagrostis epigeios, Agrostis stolonifera, Geum urbanum, Hypericum perforatum, H. umbelatum, Poa angustifolia, P. nemoralis, Lysimachia nummularia, Juncus effusus, Polygonum hydropiper, Scrophularia nodosa, Galium aparine, G. Mollugo, Cruciata laevipes, C. glabra, Ajuga reptans, Veronica chamaedrys, Sedum maximum, S. cepaea ș.a.*

Among the sub-shrub species may be also found: *Chamaecytisus hirsutus and Cytisus nigricans* (rarely).

The grass layer is usually well-developed, with a coverage of 30% - 70% of the surface, depending on the illumination degree.

Correspondence with:

- **type of forests**[1]**: 7111** – Normal hills Turkey oak stand (s); **7112** – Hills Turkey oak stand of medium productivity (m); **7121** - Normal plain Turkey oak stand (s); **7123** – Plain Turkey oak stand of medium productivity (m);
- **type of forest sites**[2]**: 7.4.1.1.** - Hilly mixed oak stand with common oak Pm, white and typical **epihipostagnic** – mezzo-stagnic luvisols, cu *Poa pratensis-Carex caryophyllea*;
- **plant associations**[3]**:** *Quercetum cerris* Georgescu '41;
- **type of habitats**[4]**: R4150** – Danubian - Balkan forests of turkey oak (*Quercus cerris*) with *Festuca heterophylla.*

Current status of the trees and management measures (particularities):

f. The structure of the stands: in figure 2 it is presented the distribution of the number of trees by diameter categories, and in figure 2 the vertical and horizontal structure of a representative stand from u.a. 67C, U.P.IV, in which inventories were made. The composition of the stand: 9Ce 1Go disSt, age 100 years, number of trees per hectare: turkey oak - 154, sessile oak - 16, common oak - 4.

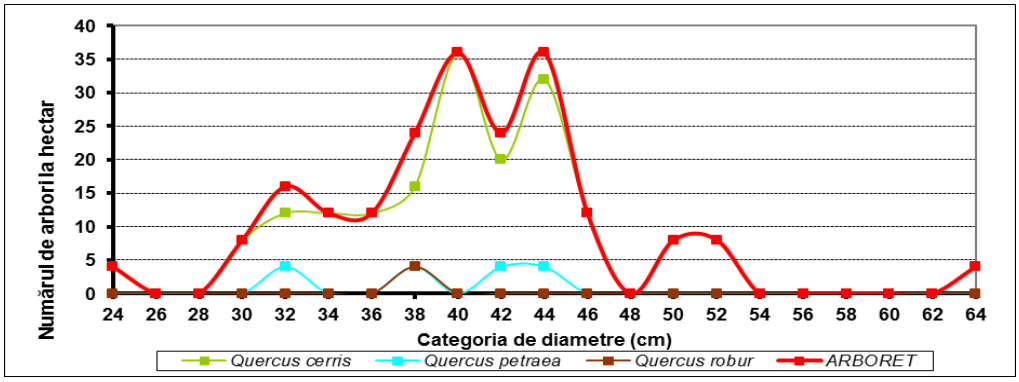
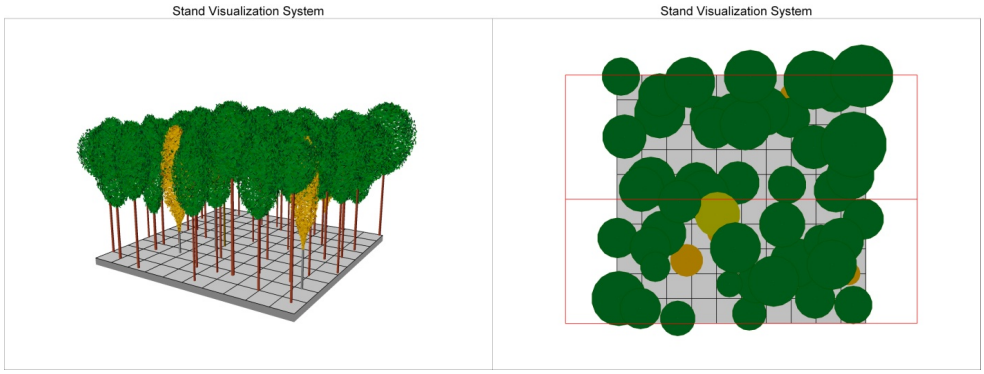


Fig. 2. The distribution of tree numbers per hectare in stand, according to diameter categories and species in u.a. 67C, U.P. IV Topile area

[1] Forest types are defined according to N. Doniță et al., 2005.
[2] Types of stands are defined according to F. Dănescu, C. Costăchescu, Elena Mihăil, 2010.
[3] Plant associations are defined according to N. Doniță et al., 1990, the new types of ecosystems according to V. Sanda, A. Popescu, D. I. Stanciu, 2001.
[4] Types of habitat are defined according to N. Doniță et al., 2005.



Legend:

Quercus cerris *Quercus petraea* *Quercus robur*

Fig. 3: The diagram of vertical structure (left) and plan projection of the canopy (right) for test plot of 2500 sqm, using SVS software, 3.36 version, in u.a. 67C, U.P. IV Topile area

g. Distribution according to age intervals: 6-10 years - 3%; 11-20 years - 6%; 21-40 years - 18%; 41-80 years - 73%.

h. The source of the main elements of the stand: turkey oak – natural seeding 22%, shoots 66%, plantations 12%; sessile oak – natural seeding 6%, shoots 26%, plantations 68%; common oak – natural seeding 13%, shoots 29%, plantations 58%;

i. Production classes of the main species of the stand: turkey oak cl III/II; Sessile oak cl III; Common oak cl III/IV.

j. Natural regeneration through seeding: turkey oak regenerates very well, sessile oak, common oak, hungarian oak, as the other mixed species regenerate less actively, but in more favorable micro-stations, especially in valleys, they regenerate better.

k. Indicated composition: 5Ce 3Go(Gâ,St) 2Ju,Ar,Ulc,Pă,Mă.

Fig. 4: Turkey oak stand with *Genista-Festuca heterophylla,* in u.a. 67C, U.P.IV Topile area, (photo - P.T. Moțiu)

l. Management measures on age intervals: 0-5 years – decomposition of natural regenerations and/or plantations, completions with poorly represented main species (sessile oak, hungarian oak, common oak), as well as with aid species; 6-10 years – promoting the vigorous, well-conformed turkey oak species, the sessile oak, the hungarian oak, the common oak, by applying recesses, and other species where possible. It is compulsory to maintain the mixed species (walnut, field elm, hornbeam, tarred maple and forest pear) to create a sub-layer; 11-20 years – proportioning the mixture according to the determined target composition, by clearing, focusing to the maintenance of mixed oak trees in sustainable proportions, but also of the aid species; 21-40 years – choosing the future trees (from seed) from the main species - turkey oak, but also from the other species (sessile oak, hungarian oak, common oak) and applying combined cutting around these trees; 41-80 years – continuing the promotion of future trees by combined cutting, keeping the rest of the massif closed; over 80 years – applying hygiene cuts; helping natural regeneration by removing the sub-tree and mobilizing the soil.

m. Other management measures: introduction in the composition of the arboretum of some species of aid (preferably the common maple); the trees arising from shoots will be converted gradually, by natural regeneration as far as possible (if the tree is at the age of fructification) or by restoration. In case of crops with ecologically unspecified species (acacia, black pine, wild pine), it is recommended to replace them with native species adapted to local seasonal conditions. The works of helping natural regeneration are mandatory in the years with abundant fructification in case on the mixed species (sessile oak, hungarian oak and common oak).

Recommended forestry measures: it is recommended the promotion of hungarian oak in this type of ecosystem, at the expense of turkey oak. In more favorable seasonal conditions (with partially sunny or shady exposure and higher soil trophicity) it is indicated the introduction of sessile oak in the arboretum composition.

Contraindicated forestry measures: the artificial formation of pure cultures (monocultures) of turkey oak (plantations or artificial seeding) is not recommended. The Oak is contraindicated to be planted under such seasonal conditions (it suffers from the summer drought); it may be introduced, eventually, at the base of the slopes where these conditions improve, being more favorable to its installation and development.

n. Variability and successional trends (forms of type, succesional tendencies and forest facies): This type of forest ecosystem presents a typical slope shape and a typical terrace (plateau) shape. The slope form has the same type of grassy flora as the terrace form, but with abundance – lower dominance, so with less soil cover (up to 30% of the total surface); the terrace shape presents a higher soil cover (up to 50% and even more). On flat places (terraces, plateaus), we find the form with a mixture of mixed oak stand, passing towards the type **7833** - Mixed oak stand with *Agrostis-Carex brizoides* (on the Piedmont plain), the form with sessile (sometimes also oak), passing towards the type **5724** - Turkey oak-sessile oak stand with hornbeam with *Glechoma-Geum* (on the low hills), and the form with hungarian oak (sometimes common oak), passing towards type **7435** - Turkey oak-hungarian oak stand with *Genista-Festuca heterophylla* (on the Piedmont plain). On the slopes we find the form with hornbeam, passing towards type **7214** - Turkey oak stand with hornbeam with *Arum-Brachypodium* (near the valleys).

At the transition to the type of ecosystem **5535** - Sessile oak-turkey oak-hungarian oak stand with *Genista-Festuca heterophylla*, the hornbeam and the hungarian oak perform within this type a transition form with hornbeam and hungarian oak. At the transition to the form with turkey oak within the type of ecosystem **5135** - Sessile oak stand with *Genista-Festuca heterophylla*, the sessile oak realizes within this type a transition form with sessile oak (U.P.III, u.a.62A: 8Ce 2Go). Hungarian oak and the common oak perform within this type of ecosystem a transition form towards the form with oak of the forest ecosystem type **7435** - Turkey oak-hungarian oak stand with *Genista-Festuca heterophylla*.

Within this type, on the plateaus, in some cases, e.g. in U.P.I u.a.89, U.P.II u.a.20, U.P.III u.a.64B, we encounter a form of transition to the type of ecosystem **6833** - Common oak-turkey oak stand with *Agrostis-Carex brizoides*, more precisely towards the middle productive subtype of this type (68332), characterized by the mosaic of the grassy sub-shrub layer.

o. Observations: The composition of the trees is variable on the surface, ranging from pure turkey oak to mixtures with hornbeam, with oak with hungarian oak or with some of these species. There is a tendency to form trees with a majority of turkey oak or with hungarian oak on the plateaus and with the other two mixed oak stand species (sessile oak and common oak) on the slopes. It is remarkable the succession of trends towards the neighboring ecosystem, e.g. towards **7435** - Turkey oak-hungarian oak stand with *Genista-Festuca heterophylla*, **7214** - Turkey oak stand with common hornbeam with *Arum-Brachypodium* (towards the valleys), **6833** - Common oak-turkey oak stand with *Agrostis-Carex brizoides* (on the plateaus).

In more favorable seasonal conditions, the turkey oak and the hungarian oak may achieve the second production class (e.g.: U.P.IV, u.a.5E).

In this type of forest ecosystem, we find trees with a lower productivity (e.g.: U.P.II, u.a.: 25A, 26, 28, 33, 34A, 34C, 39A), although the resort is of medium quality; the cause lies in the origin of these from shoots.

The regional variant is characterized by the presence of mixed common oak, sessile oak and hungarian oak.

CONCLUSIONS

Therefore, it is evident that the regional variants of forest ecosystem types arise due to the influence of reginal variants of climate and soil (pedogenetic sub-layers) - the main forest sites factors.

I tried, within this research, to establish ecosystem-based forest type existing in a territory smaller but representative for the high plain units within Tinca Forest District, to state the current status of types and propose appropriate management measures to bring forest types as close as possible to the natural state.

This priority of this period is to establish types of forests on small geographic units, at the level of landscapes, the typology having thus a strong regional feature.

Forest typology evolved from the necessity of differentiating management measures of the forests according to composition, structure, productivity, features of the stands i.e. after their eco-systemical features.

REFERENCES

1. Beldie Al., Chiriţă C., 1967, Flora indicatoare din pădurile noastre. Ed. Agro-silvică, Bucureşti.
2. Ciocârlan, V., 2000, Flora ilustrată a României. Ed. Ceres, Bucureşti.
3. Chiriţă C., Tufescu V., Beldie Al., Ceucă G., Haring P., Stănescu V., Toma G., Tomescu Aurora, Vlad I., 1964, Fundamentele naturalistice şi metodologice ale tipologiei şi cartării staţionale forestiere, Ed. Academiei, Bucureşti.
4. Chiriţă C., Vlad I., Păunescu C., Pătrăşcoiu N., Roşu C., Iancu I., 1977, Staţiuni forestiere, Ed. Academiei R.S.R., Bucureşti, p. 518.
5. Cristea, V., Gafta, D., Pedrotti, F. 2004, Fitosociologie, Ed. Universitară Clujeană, ClujNapoca.
6. Dănescu F., Costăchescu C., Drăgan Dorina, 2010, Corelarea Sistemului român de clasificare a solurilor cu (SRCS, 1980) cu Sistemul român de taxonomie a solurilor (SRTS, 2003), Ed. Silvică, Bucureşti p. 80.

7. Dănescu F., Costăchescu C., Mihăilă E., 2010, Sistematica stațiunilor forestiere, Ed. Silvică, București, p. 253.
8. Doniță N., 2004, Tipologia forestieră integrată și sarcini de viitor ale tipologiei forestiere în România, Revista Pădurilor, No. 2/2004.
9. Doniță N., Chiriță C., Stănescu V. et al., 1990, Tipuri de ecosisteme forestiere din România, C.M.D.P.A., I.C.A.S., București.
10. Doniță N., Popescu A., Păucă-Comănescu Mihaela, Mihăilescu Simona, Biriș I., 2005, Habitatele din România, Ed. Tehnică Silvică, București.
11. Doniță N., Borlea F., Turcu D., 2006, Cultura pădurilor. Ed. Eurobit, Timișoara, p. 367.
12. Florescu I., Nicolescu N., 1996, Silvicultura, Vol. I, Studiul pădurii, Ed. Lux Libris, Brașov, p. 210.
13. Florea, N., Munteanu, I., 2003, Sistemul român de taxonomie a solurilor (SRTS), Ed. Esfalia, București.
14. Florescu I., Nicolescu N., 1998, Silvicultura, Vol. II, Silvotehnica, Ed. Universității Transilvania din Brașov, p. 194.
15. Giurgiu V., 2004, Probleme actuale ale tipologiei forestiere Românești, RevistaPădurilor, No. 2/2004.
16. Mc.Gaughey, Robert J., 1999, Stand Vizualisation System (SVS vers. 3.36). USDA Forest Service, Pacific Northwest Research Station.
17. Moțiu P.T., 2004, Caracteristici dendrometrice ale unor specii alohtone cultivate în O.S. Tinca, Jud. Bihor, Analele Universității din Oradea, Fascicula Silvicultură, pp. 135-144.
18. Motiu P.T., Bartha Sz., 2006, Progresive clear-strip felling simplified in total regeneration stand, The 4thInternatinal Symposium „Natural resources and sustainable development", Annals of the University of Oradea, Forestry Fascicula, University of Oradea Printing House, pp. 407-410.
19. Moțiu, P.T., 2011, Typological research of forest ecosystems from Crișul Negru Plain and Hills of Tășad. „Risk Factors for Environment and Food Safety". Ed.Universității din Oradea, pg. 580 -588.
20. Moțiu P.T., 2011. Contributions to sustainable management measures, based on the type of forests from Crișul Negru Plain and Hills of Tășad. „Risk Factors for Environment and Food Safety". Ed.Universității din Oradea, pg. 589 - 598.
21. Moțiu P.T., Bucur L., Nistor S., 2011, Contribution to the typological substantiation of the forestry using gis tools in Crișul Negru plain and Tășadului Hills, "Risk Factors for Environment and Food Safety", Annals of the University of Oradea, Forestry Fascicula, University of Oradea Printing House, pp. 572-579.
22. Moțiu P.T., Bucur L., Nistor S., 2012, Researches on types of forest ecosystems in the Crisul Negru Low Plain, „Risk Factors for Environment and Food Safety", Annals of the University of Oradea, Forestry Fascicula, University of Oradea Printing House, pp. 516-529.
23. Moțiu P.T., Bucur L., Nistor S., 2012, The methodology of elaboration researches regarding typology studies and typological mapping of forest ecosystems in Crisul Negru Plain and Tasadului Hills, „Risk Factors for Environment and Food Safety", Annals of the University of Oradea, Forestry Fascicula, University of Oradea Printing House, pp. 507-516.
24. Moțiu P.T., Bucur L., Nistor S., 2013, Research on 5225 forest ecosystem type sessil oak with common hornbeam with Carex pilosa within the segment of landscape situated on low hills of Tinca forest district. „Risk Factors for Environment and Food Safety". Ed. Universității din Oradea, p. 453 - 462.
25. Motiu P. T., Bucur L., Nistor S., 2013, Research on 7214 forest ecosystem type turkey oak with common hornbeam with Arum-Brachypodium within the segment of landscape situated on high plain of Tinca forest district. „Risk Factors for Environment and Food Safety". Ed. Universității din Oradea, p. 463 - 472.
26. Motiu P. T., 2014, Research of the Main Types of Forest Ecosystems on the West Crișana Low Hills. „Risk Factors for Environment and Food Safety". Ed.Universității din Oradea, p. 503 - 508.
27. Motiu P. T., 2015, Research of the Main Types of Forest Ecosystems on the West Crișana Piedmont Plain. „Risk Factors for Environment and Food Safety". Ed.Universității din Oradea, p. 325 - 332.
28. Motiu P. T., 2016, The importance of knowing geology and geomorphology of a territory regarding typological research on geographical landscape segments. Ed. Universității din Oradea, p. 437 - 444.
29. Motiu P. T., 2017. Research on 4236 forest ecosystem type european beech stand with Festuca drymeja within the segment of landscape situated on low western hills of Tinca forest district. „Risk Factors for Environment and Food Safety". Ed. Universității din Oradea, p. 203 - 210.
30. Motiu P. T., 2018. Research on 5535 forest ecosystem type sessil oak-turkey oak-hungarian oak mixed stand with Genista-Festuca heterophylla (regional version on stagnic luvosoles) within the segment of landscape situated on low western hills of Tinca forest district. „Risk Factors for Environment and Food Safety". Ed. Universității din Oradea, p. 135 - 144.
31. Paşcovschi S., Leandru V., 1958, Tipuri de pădure din R.P.R., Ed. Agro-Silvică, București.
32. Paşcovschi S., Avram C., Constantinescu N., Petrescu L., Popa G., 1964, Complexe de măsuri silvotehnice pentru tipuri de pădure din Republica Populară Română, Ed. Agro-Silvică, București.
33. Târziu D.R., 2006, Pedologie și stațiuni forestiere, Ed. Silvodel, Brașov.
34. Târziu D., Spârchez G., Dincă L., 2004, Solurile României, Ed. „Pentruviață".
35. * * *, 1999, Amenajamentul O. S. Tinca - Studiul general, București.
36. * * *, 2004, La typologie des stations forestières. Inventaire Forstier National.
37. * * *, 2007, Amenajamentul O. S. Tinca - Studiul general, Bucureşti.