PHYTOCOENOLOGICAL AND ECOLOGICAL STUDY OF BEECH FORESTS FROM PĂDUREA CRAIULUI MOUNTAINS (NORTH-WESTERN ROMANIA, BIHOR COUNTY)

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Abstract

The Pădurea Craiului Mountains have a surface of about 1150km^2, and resemble a platform fragmented in a series of peaks and isolated massifs or under the form of hills whosw heights decrease from south-east to north-west. The climate is different according to the altitude, ranging from a relatively warm climate, humid enough in the low marginal territories to arelatively warm climate, humid enough in the low marginal territories to a relatively cold and humid climate in the high places from the south-east part of the massif. From a phytosociologic point of view, the beech forests of the Pădurea Craiului Mountains are included in the following associations: Symphyto cordati – Fagetum, Pulmonario rubrae – Fagetum, Hieracio rotundati – Fagetum, Phyllitidi-Fagetum, Epipacteto – Fagetum.

Key words: phytosociology, association, beech forest, mountains, North-Western Romania, Bihor County.

INTRODUCTION

The Pădurea Craiului Massif, located in the northwestern part of the Apuseni Mountains, looks like a horst raised above the Vad-Borod Depression (transected by the Crişul Repede River) in the north and above the Beiuş-Holod Depression (transected by the Crişul Repede River) in the east. The massif is bordered by the Bihorul Mountains to the East, and are divided from them by the Iadei Valley; in the West, they are bordered by the Tăşadului Hills, which are divided by the Topa Valley.

Relief

The Pădurea Craiului Mountains have a surface of about 1150 km^2, resembling a platform fragmented in a series of peaks and isolated massifs or under the form of hills whose heights decrease from south-east to north-west. The maximum elevation in the south-east side range from 1027 m (Hodrancusa) to 850m (Culmea Ponorului), and those from the center of the massif from 851 m (Carmazan) to 624m (Osoi), and those from north-west go down till 500-600 m in the south-east and 350-400 m in the north-west. Regardless of the relatively low altitudes, the massif has a mountaneous feature due to the constituent rocks and the strong fragmentation of the relief.

Hydrographic Network

The hydrographic network consists of the Iada, Baiu, Brătcuţa, Misid, Izbandis and Galseni Rivers, Which are tributaries of the Crisul Repede River and the Valea Rosia, Holod and Topa tributaries of the Crisul Negru River.

There are also several secondary valleys providing a temporary runoff and, at times, the surface runoff is replaced by the subsurface runoff in the karstic systems.

Climate

The climate differs according to altitude, ranging from relatively warm climate, humid enough in the low marginal territories, to a relatively cold and humid climate in the high places from the south-east part of the massif. The climate of the majority of the territory corresponds to an altitude of 600-800 m, is characterized by annual average temperatures of +8, +7 C and annual average precipitation of 850-900 mm, with a favorabile distribution of precipitation in the April-September vegetative season. The thermic regime remains also favorable for the mountaneous beech forest in alternance with *Festuca rubra* meadows on neutral soils and with *Deschampsia flexuosa* and *Nardus stricta* meadows on acid soils.

Soils

The soil cover is highly varied in the Pădurea Craiului Mountains. In the first half of the south – east part, there are rendsinas on limestones and acid brown soil metamorphic rocks over large surfaces. In the central part, large areas are covered by the complex of eumesobasic brown soil and to argillic brown soils and podzolic brown soils. Locally therea are some Terra rossa soils.

MATERIAL AND METHODS

The material under research is represented by the beech forests in the Pădurea Craiului Mountains, where we made over 150 surveys during1997-2001. The surveys and notations regarding the structure of the beech forest's phytocenoses were made according to Borza and Boşcaiu (1968), Coldea (1991), Burescu and Doniţă (2001) and Burescu et al. (2001). The identification of beech associations was made on a floristic criterium, with the help of the characteristic species without neglecting the illustrative and dominant species. For a precise characterization of their association, we made more than 25 surveys of phytocenoses of the same type. The sampling areas, homogenously floristically and physionomically, were chosen from the fragments characteristic to the forest phytocenoses, with a surface of 1000 m^2 for the even-aged beech forests and 2500m^2 for the multi-storeyed ones.

RESULTS AND DISCUSSIONS

The structure of biocenosis of beech forests in the Pădurea Craiului Mountains

The biocenosis of beech forest includes three strata: trees, shrubs and herbs, mentioning that the stratum of shrubs is very poorly developed and sometimes misses completely.

The tree stratum includes the following species : *Fagus sylvatica, Carpinus betulus, Ulmus glabra , Acer pseudoplatanus, Acer campestre, fraxinus excelsior, Prunus avium.* The beech is predominant (more than 90%). The general coverage is of 0,7-0,9 and locally it is of 1.0. The diameter of the beech crowns differs greatly, from 2 to 12 n; there is a permanent tendency towards an asimetric grrowth of the crown, with the largest part towards the valley. This situation is determined by the strong tendency of the crowns to develop towards the light, given the disposal in storeys of the trees on the large northern slopes. The vertical structure is non-uniform, the height variations of different categories of trees being high, from 5 to 26 m, locally having even a multi-storeyed character. The average height is 18,4 at 65 years old and the stand productivity is variable from the second class of production to the fourth.

The shrub stratum includes: *Corylus avellana, Sambucus nigra, Salix capraea, Rubus hirtus, Euonymus latifolia, Daphne mezereum, Rubus idaeus* realizing a coverage below 0.1.

The herbaceous stratum includes the species:

Galium odoratum, Cardamine bulbifera, Cardamine glandulifera, Isopyrus thalictoides, Viola reichenbachiana, Lamium galeobdolon, Oxalis acetosella, Crydalis bulbosa, Arum maculatum, Gymnocarpium dryopteris, Dryopteris filix-mas, Athyrium filix-femina, Pulmonaria officinalis, Pulmonaria rubra, Anemone nemorosa, Anemone ranunculoides, Euphorbia amygdaloides, Salvia glutinosa, Ranunculus auricomus, Sanicula europaea, Scilla bifolia, Melica uniflora, Carex sylvatica, Carey digitata, Hedera helix, Geum urbanum, Fragaria vesca, Aposeris foetida, Hepatica nobilis, Mercurialis perennis, Asarum europaeum, Festuca drymeia, Polygonatum multiflorum, Polygonatum verticillatum, Glechoma hederacea, Erithronium dens-canis, Stellaria nemorum, Luzula luzuloides, Geranium robertianum, Phyllitis scolopendrium, Polypodium vulgare, Symphytum cordatum, Helleborus purpurescens, Lathyrus vernus, Scrophularia nodosa, Ajuga reptans, Chrisosplenium alternifolium, Primula veris, Lathyrus tuberosus, Astragalus glycyphyllos, Doronicum austruacum, Doronicum columnae, Allitaria petiolata, Lactuca seriola, Deschampsia flexuosa, Mycelis muralis, Atropa belladonna, Circaea lutetiana, Chelidonium majus, Stachys sylvatica, Aegopodium podagraria, Cephalanthera longifolia, Cruciata laevipes.

It was found that the herbaceous stratum has great biodiversity, some of the species being indicator plants of soil, rock and moisture, with some being rare or extinct.

THE BEECH FOREST ASSOCIATION IN THE PĂDUREA CRAIULUI MOUNTAINS

From a phytosociologic point of view, the beech forests from the Pădurea Craiului Mountains are included in the following associations: *Symphyto cordati-Fagetum, Pulmonario rubrae-Fagetum, Hieracio rotundati-Fagetum, Phyllitidi – Fahetum, Epipacteto-Fagetum*.

As. Symphyto cordati – Fagetum Vida 1959 (Syn: Fagetum carpaticum auct. Roman; Fagetum dacicum Beldie 1951; Festuco drymeae – Fagetum Morariu et al. 1968).

The phytocenoses of these associations grow on plane lands to slightly inclined, on eumesobasic brown soil, rich in humus, of mull type, hydrologically balanced having a trophicity ranging from an average to hogh leve, being poorly skeletal.

The composition of the tree stratum is made of *Fagus sylvatica, Acer campestre, Carpinus betulus, Sorbus torminalis,* that have a hight of 18,6 m (22m) and a cover of 75-85%. The monodominant and illustrative species is *Fagus sylvatica.* In the shrub stratum there are found: *Cornus mas, Corylus avellana, Crataegus monogyna, Sambucus nigra.* In the herbaceous stratum from the pure beech forests it is noticed the presence of *Symphytum cordatum* with a cover of 10-15% which is a characteristic and differential species for the association.

In the composition of the herbaceous stratum there are a large number of species specific to ***Symphyto-Fagion*** alliance: *Pulmonaria rubra, Festuca drymeia, Cardamine glanduligera, Aconitum moldavicum, Helleborus purpurascens, Aremonia agrimonoides;* ***Fagetalia sylvaticae*** order: *Galium odoratum, Geranium robertianum, Lamium galeobdolon, Asarum europaeum, Mercurialis perenis, Cardamine bulbifera, Salvia glutinosa, Oxalis acetosella, Gymnocarpium dryopteris, Viola reichenbachiana, Euphorbia amygdaloides, Daphne mezereum, Astragalus glycyphyllos, Corydalis solida, Sanicula europaea, Hepatica nobilis:* ***Querco-Fagetea*** *class: Arum maculatum, Corylus avellana,*

Acer campestre, Athyrium filix-femina, Dryopteris filis-mas, Melica uniflora, Anemone ranunculoides, Scilla bifolia, Glechoma hederaceae, Eranthis hiemalis, etc.

As. Phyllitidy – Fagetum Vida (1959) 1963, (Syn: Phyllitidi – Aceretum; Acereto-Fagetum auct. Roman).

The phytocenoses of these associations vegetate on stony lands with calcareous rocks found in the inferior third of the shady abrupt slope, of streams and valleys'quays from the Pădurea Craiului Mountains. The phytocenoses appear on rendsine soils that are wet or less wet, rich in calcarous skeleton, with a reduced stratum of humus, of mull type , as a type of intrasonal vegetation in the middle of the beech forests. In the tree stratum of the phytocenosis, *Fagus sylvatica* and *Acer pseudoplatanus* are codominant species that have an average cover of 70-85%. In this composition, there are also *Acer campestre, Carpinus betulus, Prunus avium.* In the composition of shrub stratum, therte are *Sambucus nigra, Corylus avellana, Euonymus latifolia, Solanum dulcamara, Hedera helix, Clematis vitalba,* etc.

In the composition of the herbaceous stratum, there are some species characteristic for the ***Phyllitis-Fagenion*** suballiance nom.nov.: *Phyllitis scolopendrium* having a cover of 15-20% being followed by *Asplenium trichomanes, Athyrium filix-femina, Phegopteris dryopteris, Dryopteris filix-mas, Polypodium vulgare, Saxifraga cuneifolia, Asarum europeum, Symphytum tuberosum, Campanula persicifolia, Arum maculatum, Hepatica nobilis, Mercurialis perennis:* ***Symphyto-Fagion*** alliance: *Symphytum cordatum, Pulmonaria rubra, Festuca drymeia, Cardamine glandulifera;* ***Fagetalia sylvaticae*** order:*Lamium galeobdolon, Mycelis muralis, Galium odoratum, Anemone ranunculoides, Rubus hirtus, Corydalis solida, Cardamine bulbifera, Isopyrum thalictroides, Lathyrus vernus, Sanicula europaea, Salvia glutinosa;* ***Querco-Fagetea*** class: *Corylus avellana, Acer campestre, Acer pseudoplatanus, Carpinus betulus, Euonymus latifolia, Hedera helix, Clematis vitalba, Astragalus glycyphyllos, Geranium robertianum, Oxalis acetosella, etc.*

As. Hieracio rotundati – Fagetum (Vida 1963) Tauber 1987 (Syn: *Luzula-Fagetum* auct. Roman.; *Fagetum dacicum luzuletosum* Beldie 1951; *Deschampsio flexuosae – Fagetum* Soo 1962).

The phytocenoses of these associations cover smaller surfaces on the top or no the inclined and sunny slopes of Pădurea Craiului Mountains.

They usually grow on acid rocks that came out at the surface with luvic brown soils, acid brown soils, oligomesobasic, superficial and lacking in humus soils. In the tree stratum, *Fagus sylvatica* is the monodominat species that has an average cover of 75-85%. In the herbaceous stratum there are species characteristic for the ***Calamagrostis – Fagenion*** suballiance, including *Luzula luzuloides* with an average cover of 5-15%, *Calamagrostis arundinacea, Hieracium rotundatum;* ***Symphyto-Fagion*** alliance: *Festuca drameia, Cardamine glanduligera, Verbascum lanatum ssp. hinkei;* ***Fagetalia sylvaticae*** order: *Galium odoratum, Lamium galeobdolon, Oxalis acetosella, Viola reichenbachiana, Cardamine bulbifera, Euphorbia amygdaloides, Anemone nemorosa, Geranium robertianum, Mercurialis perennis;* ***Oquerco-Fagetea*** class: *Dryopteris filiy-mas, Athyrium filix-femina, Geum urbanum, Stellaria nemorum, Glechoma hederacea,* etc.

As. Pulmonaria rubrae – Fagetum (Soo 1964) Tauber 1987 (Syn: *Pulmonario rubro – Abieti – Fagetum* Soo 1964; *Abieti – Fagetum* auct. Roman; *Fagetum dacicum abietetosum* Beldie 1951).

The phytocenoses of this association can be found at the highest altitudes 900-1100 m on strong to average inclined, sunny slopes, on brown soils on calcareous substartum and less on acid brown soils. The illustrative species for the tree stratum are: *Fagus sylvatica, Abies alba, Picea abies, Acer pseudoplatanus.*

Fagus sylvatica is predominant in comparison to *Abies alba* which in some areas vegetates mostly as an underwood, and in other areas as a stand, being on the same height with the beech.

In the herbaceous stratum it can be noticed species specific for *Pulmonaria rubra* association and those characteristic for ***Symphyto-Fagion*** alliance: *Cardamine glanduligera, symphytum cordatum, Helleborus purpurescens, Festuca drymeia, Euphorbia carniolica;* ***Fagetalia*** order: *Galium odoratum, Mercurialis perennis, Oxalis acetosella, Epilobium montanum, Euphorbia amygdaloides, Geranium robertianum, Mycelis muralis, Cardamine bulbifera, Lamium galeobdolon, Rubus hirtus, Sanicula europaea, Anemone ranunculoides, Bromus benekii, Campanula ranunculoides, Carex sylvatica, Circacea lutetiana, Daphne mezereum, Isopyrum thalictroides, Salvia glutinosa, Symphytum tuberosum ssp. Nodosum,* etc; ***Querco-Fagetea*** class: *Athyrium filix-femina, Galium schultesii, Poa nemoralis, Anemone nemorosa, Brachypodium sylvaticum, Corylus avellana, Melica uniflora, Moehringia trinervia, Lonicera, Lonicera xylosteum, Lonicera nigra,* etc.

This association makes the transition from the beech forests of *Symphyto cordati – Fagetum* to regional spruce forests of *Hieracio rotundati – Picetum.*

As. Epipacteto – Fagetum. Resmeriță 1972 (Syn: *Cephalanthera – Fagetum* auct. Roman. Non. Oberd. 1957).

The phytocenoses of this association grow on rendsinic, humic-calcareous, eutrophic, mesotrophic, carbonatic-eubasic, hydrically balanced soils on sunny slopes.

The soecies characteristic for this association are: *Fagus sylvatica* and *Epipactis helleborine*. The herbaceous stratum is made of the species characteristic for ***Symphyto-Fagion*** alliance: *Cephalanthera longifolia, Cardamine glanduligera, Festuca drymeia, Pulmonaria rubra* and the flora specific for the mull type soils belonging to ***Fagetalia sylvaticae*** order, ***Querco-Fagetea*** class: *Galium odoratum, Euphorbia amygdaloides, Cardamine bulbifera, Lamium galeobdolon, Mercurialis perennis, Sanicula europaea, Arum maculatum, Gymnocarpium dryopteris, Viola reichenbachiana, Carex sylvatica, Pulmonaria officinalis* etc.

The beech forests of this association develop in specific site conditions, having a regional, termophillic, humuso-chalcophile character being found at the margins of the inferior mountaneous beech forests.

CONCLUSIONS

1. The beech forests can be found along the whole Carpathian area of the beech, being made of pure and mixed forests, where the beech forest from the Apuseni Carpathians can be added.
2. The beech forets from the Piatra Craiului Mountains are represented by pure beech forests: *Symphyto cordati-Fagetum, Hieracio rotundati – Fagetum, Epipacteto-Fagetum,* that cover the main part of the area, where the beech is the monodominant species.
3. On more reduced areas, the beech forests belong to *Pulmonaria rubra – Fagetum* association where the beech is in report of codominance with the fir-tree and spruce.
4. A particular type of beech forest is *Phillitidi-Fagetum*, that grows on steeps with calcareous substratum, quays, narrow and closed valleys in shady sites on fixed or semi-mobile gravel, on rendsinic soil, rich in humus and moistured enough.

5. Under the inferior limit of beech forests (600m) there are vegetating the forests belonging to *Petraeo-Fagetum, Carpino-Fagetum, Festuco drymeiae – Quercetum petreae, Quercetum petreae-cerris* associations.

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