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THE VEGETATION OF THE UPPER PART OF THE ARIEŞUL MARE - ARIEŞUL MIC INTERFLUVE (BIHOR MOUNTAINS)

-Summary of the PhD Thesis-

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Introduction

Nature has always been the place of man's existence and now, in the post-modern era, after the "industrial adventure", a back-to-nature trend increasingly develops. Vegetation is an essential part of the natural framework and has a major importance in all components of human life, from the most pragmatic economic aspects, through those related to our physical and mental health to the aesthetic and spiritual ones. Thus, the knowledge of vegetation and its features has been and will continue to be a priority to all of us.

The Biharia Massif, "The Cucurbita Mountain", including the tallest peak in the Apuseni Mountains has been visited for botanical purposes since the 19th century, especially for its cryo-nival relief and for the vegetal communities in the Cepelor Valley. Nevertheless, it lacked a unitary study of vegetation, as it was less interesting than the calcareous Northern Bihor Mountain. The vegetation aspects published in this area are few and disparate.

This work proposes to present a unitary vision of the vegetation in this area with a high tourist and conservation potential, confirming the older data with recent researches and thus modestly contributing to the knowledge of Romania's vegetation.

In this regard, we have set the following ***objectives****:*

1. identification of the main types of vegetation and associations composing them*,*

2. description of the association, the coenotic and ecological characterization of their phytocoenoses*,*

3. the development of the alliance level vegetation map of the studied area,

4. the analysis of the existing Natura 2000 habitats and the description of some conservation aspects,

5. the description of the cormophytes taxa described in the reviewed literature or detected in the studied area, beginning with 1870 until now, indicating the information sources for each taxon.

Chapter I.: The physical-geographical characterization of the studied area

1.1. The geographic location and the boundaries of the studied area

The studied area is located in the South-Western part of the Apuseni Mountains and includes the North-Eastern part of the Biharia Massif.

The boundaries of the studied area, to the North-East the border is represented by the Arieş Mare River, from the Vârtop village, through Arieşeni to the Gârda de Sus. The Eastern border is represented by the valley of the Iarba Rea (Ghizghițul) river – which flows into the Arieşul Mare at Gârda – and the valley of the Drăghița River, which flows in the opposite direction and flows into the Arieşul Mic River upstream of the Târsa village. The Southern limit is represented by the Arieşul Mic River, from its source, in the South of the Bihor Peak, to the Târsa village. The Western border of the studied area follows the actual border of the forests on the Western slope of the Biharia Massif.

The studied area measures approximately 100 km^2, including approximately 2/3 of the surface of Biharia Massif geomorphologic unit. The approximate geographical coordinates are 46°23’ – 46°30’ latitude N and 22°39’ – 22°48’ longitude E.

1.2. The relief

The Biharia Massif represents the best individualized ensemble in the Bihor Mountains and lies from the Arieşul Mic valley in the South to the North of the Vârtop saddle, representing the Southern compartment of the Bihor Mountains.

The relief of the Biharia Massif is polycyclic (Oancea *et al.*, 1987), differentiating several leveling planes (pediplains): Fărcaş-Cârligați, Măguri-Mărişel, and Feneş-Deva.

In most cases, the slope grade ranges between 15 and 30 degrees; the slopes in the Eastern side of the massif are mild, while those in the South-Western side, towards the Arieşul Mic valley are steeper. The exposition of the slopes is generally to the N, N-E or E, in rare cases to the S.

One remarkable feature of these mountains is the presence of some specific landforms of glacial or nivo-glacial origin or more visible on the North-Eastern slope of the Cucurbăta Mare Peak and on the Eastern slope of the Piatra Grăitoare crest.

1.3. The geological substrate

From the geologic point of view, the studied area belongs to the Northern Apuseni Mountains, with a rather high petrographic and lithological diversity, highlighted by the large tectonic movements causing the fracturing and vertical, but also horizontal

displacement of rock packages, thus losing the continuity of the rock strata (Ianovici *et al.*, 1976).

Within the Biharia Massif, the nappes are directed from the South to the North and overlap one another as follows: *The Arieşeni Nappe* underlies the rock strata. *The Poiana Nappe* overlaps the Arieşeni nappe. It outcrops in small areas, in the Piatra Grăitoare Peak and Pătrăhăiţeşti areas. *The Biharia Nappe* is located above the Poiana nappe and represents the largest outcropping formation in the studied area. Within this nappe, the Biharia series, composed of chlorite schists with albite porphyroblasts, gneiss and albite schists, represents largely the surface geologic substrate of the high area of the Biharia Massif, while the sandstones and conglomerates prevail in the lower altitude area.

1.4. The soils

The soils on the Biharia Massif crest, formed at high altitudes are brown feriiluvial (podzolic) and brown podsols (*** , 1991). As the altitude decreases, towards the Arieşul Mic, acid brown soils, eroded luvic soils and erodiosoils are found in large areas. On the slopes towards the Arieşul Mic Valley and along the Iarba Rea (Ghizghiţul) Valley, acid brown soils and lythosoils can be found in extended areas. At low altitudes, above the Arieşului Mare Valley, there is a significant area with acid brown soils and luvic brown oligobasic soils (holoacid). In a small area, at the confluence of the Iarba Rea (Ghizghiţul) and Drăghiţa valleys there are acid brown soils and feriiluvial brown soils. In the lower altitude areas from the studied region, on the Arieşul Mare and Arieşul Mic Valleys, on small areas, there are alluvial soils and protosoils.

1.5. The hydrography

The studied area overlaps the upper interfluve of the Arieşul Mare and Arieşul Mic rivers and thus includes only parts of the two rivers hydrographic basins, respectively the right side of the upper hydrographic basin of the Arieşul Mare River, with an approximately 60 km^2 area (from the source to the Iarba Rea Valley) and the left side of the Arieşul Mic hydrographic basin, with an approximately 30 km^2 surface (from the source to the Drăghiţa Valley). A small part of the studied area is included in the Crişul Negru hydrographic basin.

1.6. The climate

The study area is generally located in the moderate continental climate, the local climate is montane temperate. By its location in the ensemble of the Carpathian relief, this territory is subjected to a predominantly Western circulation in all year seasons (Kovács,

2000). By their massiveness, the Bihor Mountains represent a barrier in the path of the Western air masses so that the influence of the oceanic origin humid air masses is felt, which gives the climate a moderate continental character with mild pluvial trends. An explicit altitude climatic zoning occurs also in the study area.

The thermal regime of the area reflects mainly the topographic conditions. On the crests of Cucurbăta, the annual average temperature is about 0ºC; it decreases to 4-7ºC with the altitudinal gradient (Oancea *et al.*, 1987).

The pluviometric regime of the area has the highest values of the precipitations in the high areas related to the Râului Alb, Vârciorog, Cepelor, and Iarba Rea hydrographical basins, exceeding 1300 mm/year. Due to the predominantly Western circulation of air, in the upper basin of the Arieş River, there are average annual precipitations of 1000 - 1400 mm; beyond 1300 m altitude (Curtici, 1991) there are high values as compared to other mountainous massifs where these values are usually found at more than 2000 m.

1.7. The anthropogenic element

On the Eastern slope of the Biharia Massif, the Măguri - Mărişel and Feneş - Deva leveling planes are well represented (Oancea *et al.*, 1987), enabling the presence of the human crest settlements in the Arieşul Mare and Mic Rivers basins. The Western slope is much shorter (steeper), with very heavy rainfalls; this area lacks human settlements.

From the ***administrative*** point of view**,** the study area is located mainly in the Alba County, within the Arieşeni, Avram Iancu, and Gârda de Sus communes; a small area is included in the Bihor County, in the Crişţioru de Jos and Nucet communes.

The demographic data (Gozner, 2011) reveal a population of about 1800 inhabitants in the Arieşeni commune, respectively about 2000 in Gârda de Sus at present, which represents a decrease by almost 50% as compared to the middle of the last century, a general trend for the entire Albac-Arieşeni territorial system, which classifies the region among those with high demographic risk.

This area presents a significant ethnographic potential due to the maintenance of the village communities, as well as their culture, spirituality and their ***traditions*** unaltered. Even in the studied area there are two small museums (in Pătrăhăiţeşti and Dealul Bajului) which produce, expose and trade ***handicraft*** traditional products.

The ***tourism*** practiced in the area includes (Muntean and Nicoară, 2007): itinerant tourism with cultural possibilities; spelaeo-tourism, rural tourism, transit tourism, hiking,

winter sports tourism, repose and recreational tourism, the last two are at present the most important.

The mountain-type ***agriculture*** is less developed in the study area; the pedoclimatic conditions enable the cultivation of a small number of agricultural species. Beside the vegetable gardens near the houses, the lower grade lands are used alternatively as agricultural lands during the first years after the turning of the soil, planting especially barley, rye and potatoes, while after the planting of grass, they are used as grasslands or pastures.

Forestry practices have a major influence upon the forest vegetation. The forests within the study area are comprised, in majority, in the Gârda Forest Division and Valea Arieşului Forest Division. The structure of the woody communities is strongly affected by the selective extraction of a certain species, intensive thinnings or clear cuts, but on long term, the woody plant communities have continuity in the area.

Stock farming represents another traditional occupation in the area, with a direct and significant impact on the natural vegetation, which decreased with the demographical decline of the area. In the 60's there were several sheep yards here, at present abandoned. Beside the poultry and pigs raised in the households, the inhabitants also raise cows and horses. During the summer months, the latter are taken on the massif crest, where tens of them can be seen.

Chapter II: General characterization of the vegetation

2.1. The history of botanical researches in the area

The Biharia Massif (the Southern Bihor) which includes also the studied area – the upper interfluve of the Arieşul Mare and Arieşul Mic interfluves – is less known, with only erratic data on the cormophytic flora and vegetation.

The first floristic data in the area are presented by the Viennese botanist A. Kerner (1867-1879), two herbarium sheets with plants collected by him in this area being kept within the Herbarium of the "Alexandru Borza" Botanical Garden in Cluj-Napoca.

L. Simonkai (1886) mentions 63 cormophyte taxa from this area, while two sheets with species collected by him in this area can be found in the above-mentioned herbarium. In the same herbarium, an undated sheet from the same area occurs in the section dedicated to F. Porcius.

Indirect data referring to the cormophytes in the studied area come from the studies performed on mosses conducted by M. Péterfi (1908).

One herbarium worksheet from the area of the Biharia Massif is submitted in the same herbarium by R. Soó (in 1910), followed, in the year 1940 by another, submitted by I. Todor.

In his review of the peat swamps from Romania, E. Pop (1960) mentions also some species of cormophytes in the studied area.

In 1966, T. Simon publishes an article on the vegetation in this area.

M. Bleahu and S. Bordea's tourist guide (1967) includes also some general remarks on some flora and vegetation elements.

Flora RSR (***1952 -1976) cites over 40 cormophyte taxa from the studied area.

Between 1971 and 1975, C. Olaru conducts researches on the flora and vegetation in the Biharia Massif, in order to write a PhD thesis on this topic without completing it, though. In the published papers (Olaru, 1979, 1980, 1981), a large number of vegetation taxa are mentioned and several vegetation associations in the area are described.

During the same period, A. Marossy studies the flora of the source area of the Cepelor Valley and publishes two articles (Marossy, 1973, 1975) including a large part of the species that are found here. During the following years, A. Marossy publishes an article together with N. Boşcaiu (Boşcaiu and Marossy, 1979), describing some vegetation associations in the cirque from the source of the Cepelor Valley.

In the herbarium of the "Alexandru Borza" Botanical Garden in Cluj-Napoca, there can be found several sheets from the Arieşeni area, containing species collected by F. Rațiu, in 1978.

The tourist guide published in 1984 for the Arieşului Valley (Popescu-Argeşel, 1984) includes also some general information related to the flora in this area.

G. Coldea publishes alone (1995-1996), and then with J. Wagner (1998) certain vegetation associations in the Cucurbăta Mare Peak area.

Other flora and vegetation data from the study area are published by T. Ursu and G. Coldea (2007). Later, G. Coldea, L. Filipaş and I. A. Stoica (2008) describe a new association (*Bruckenthalio - Vaccinietum*) in the Cucurbăta Mică Peak area. In 2010, T. Ursu and C. Olaru publish a paper describing the general characterization of the Biharia Massif vegetation (Ursu and Olaru, 2010).

2.2. The evolution of vegetation during the recent geologic periods.

The postglacial period of the forests in the Apuseni Mountains follows roughly the model developed by E. Pop for the Romanian Carpathians (Pop, 1932, 1942) where the following phases succeed temporally: the pine phase; the transition phase pine - spruce; the spruce phase with mixed oak and hazel; the spruce and hornbeam phase; the spruce – beech – fir phase. As the trends and features of vegetation are relatively constant and consistent even on extended land areas in similar environmental conditions, one can consider that the general phyto-historical data regarding the Apuseni Mountains are valid also for the studied area.

The palinologic studies conducted so far in sites from the Apuseni Mountains have revealed the continuity over time of the forests in this area; their postglacial evolution is determined by the environmental factors, especially the climate, but during the last periods the influence of the anthropogenic factor has become significant (Fărcaş *et al.*, 2003).

Therefore, we can consider that during the last 10,000 years, the area subjected to study here was mostly covered by forests, probably except the crest area of the Biharia Massif, where we assume the existence of some primary extended pastures, especially during the cold period of the Tardiglacial and Preboreal. With the climate warming in Boreal and Atlantic, the surface of these pastures is likely to have been significantly reduced, as the wood vegetation grew at higher altitudes, a tendency reversed with the relative cooling of the climate in the Subboreal and Subatlantic.

The species composition of these forests probably followed the dynamic model described above for the Apuseni Mountains, with some features – especially in the lower presence of the thermophile elements within the mixed oak – correlated with the higher altitude of these mountainous areas.

2.3. The general aspect of the present vegetation

The distribution of vegetation in the Biharia Massif is modeled especially by the altitude, by the exposition and by the local microclimates and less by the geologic and pedologic features.

The woody vegetation includes approximately 75% of the studied area. From the bottom to the top, the following altitudinal stages are found: the beech stage, the mixed forest stage, the spruce stage, the juniper stage; vegetation inversion sometimes occur, usually between spruce and mixed forests.

The Carpathian beech forests (association *Symphyto cordati-Fagetum sylvaticae*) are found on small areas, until approx. 1300 m, especially on the upper segment of the Arieşului

Mic Valley and less on the Iarba Rea Valley, both located on the Southern side of the Biharia Massif.

The mixed forests, included within *Leucanthemo waldsteinii-Fagetum* succeed the beech forests on altitude; their structure is mainly influenced by the microclimate. Therefore, between 1300 and 1400 m, on the Northern slopes of the valleys, the spruce prevails in the mixed forests, while on the Southern slopes, the beech is prevalent. Currently, the beech and mixed forests dominated by beech cover approx. 27% of the studied area.

The spruce forests, of which the most representative are the *Hieracio rotundati-Piceetum* communities, are arranged in two strips: the first is located at a lower altitude, around 1000 m, generated by the local microclimate on the Râului Alb Valley and on the lower part of the valleys from the North-Eastern side of Biharia. The second spruce strip is found at high altitudes, between 1400 and 1600 m. The spruce forests, together with the mixtures prevailed by spruce, cover approx. 38% of the studied area.

In places with high soil humidity the coenoses of *Leucanthemo waldsteinii-Piceetum* appear, while on small areas where the relief favors a long-term accumulation of water (Jompului Creek, above Ştei etc.), swamped spruce forests are formed (*Sphagno Piceetum).* At the superior forest limit the spruce forest is represented by communities of *Soldanello majori-Piceetum.*

By the intensive exploitation of the forests, the entire surface of the massif is covered by thinnings, or even extended cleared areas, which are rapidly or more slowly colonized by scrubs, according to local conditions. At lower altitudes, within the beech fellings, the coenoses of *Epilobium angustifolium* appear, characteristic to deeper and less acid soils. In a more advanced stage of succession, these are replaced by coenoses of red elderberry. In case of the spruce and mixed forests fellings, the raspberry cane spreads, together with some black berry species, followed by the regrowth of forest vegetation. On steeper slopes and shallow soils, the succession does not continue directly with the spruce or mixed forests, but it goes through one extra stage, dominated by rowan and birch (*Sorbo-Betuletum pendulae*).

Juniper bushes (association *Campanulo abietinae-Juniperetum*) represent the potential vegetation for the summit of the Biharia Massif, above the limit of spruce forests. The exception is represented by few small surfaces of subalpine pasture located on the Cucurbăta Mare and Cucurbăta Mică Peaks, rocky areas that are covered by mountain alder and the humid areas with their specific vegetation.

Blueberry bushes, included within *Campanulo abietinae-Vaccinietum,* are spread especially in the high area of the Biharia Massif, on its crest and on the steep slopes, with

North-Eastern exposition below the crest, where there is a very high stability in time. On very small surfaces there are also communities where the northern bilberry (*Vaccinium gaultherioides*) prevails, especially in the area of the Cucurbăta Mare (Bihor) and Cucurbăta Mică Peaks, in windy places, especially on North-Eastern exposition. The blueberry and juniper shrubs cover approx. 6% of the studied area.

At the source of the Cepelor Valley, there are still present mountain pine shrubs of relict nature on a small area (approx. 3 ha), that we have framed within *Vaccinio myrtilli - Pinetum mugo.*

The rocky areas below the Cucurbăta Mare Peak are covered by mountain alder scrubs (*Salici-Alnetum viridis*) which are also present on a small surface near the Piatra Grăitoare Peak.

In the meadow of Arieşul Mic Valley there are present small fragments of white alder riparian corridors, specific to the valleys in the mountainous areas from Romania (*Telekio speciosae-Alnetum incanae*).

The grass vegetation is mostly of secondary origin.

The forests surrounding the localities have been cleared to make room for the agricultural lands. These are used, by crop-rotation, both for agricultural crops and for grasslands and pastures, (dominated by the coenoses of *Festuco rubrae-Agrostietum capillaris* and *Anthoxantho-Agrostietum capillaris*) and maintained by fertilization with manure. These lands cover approx. 16% of the studied area. The abandoned agricultural areas have the tendency to decrease their trophicity and increase soil acidity, being colonized by plant communities (*Polygalo-Nardetum strictae*) dominated by matgrass, blueberry and *Deschampsia flexuosa.* These degraded pastures cover approx. 370 ha in the studied area.

In the higher areas of the massif where the spruces and juniper shrubs were cleared to make room for the pastures, these are generally prevailed by matgrass, usually accompanied by a small number of other species. On small areas, in more mesophilic conditions, *Festuca nigrescens* can become dominant. The matgrass pastures (*Violo declinatae-Nardetum*) cover approx. 400 ha and are found especially on the crest of the Biharia Massif.

In a few points, on drier and more acidic soils, on sunny slopes there occur both small communities of heather (*Calluna vulgaris*), as well as spots dominated by *Bruckenthalia spiculifolia*.

On very small areas, of some tens of square meters, close to the northern bilberry patches in the highest and wind exposed spots of the massif, there are fragments of subalpine pastures included in the association *Potentillo chrysocraspedae-Festucetum airoidis.*

The hygrophilic vegetation from the studied territory includes diverse vegetation communities, that cover small areas.

At the sources of the Râul Alb (the initial section of the Arieşul Mare river) there are found communities of low area composed of soft rush (*Juncus effusus*), while downstream we have observed small patches of communities dominated by bur-reed (*Sparganium erectum* ssp. *neglectum*).

In areas with very low slope on the banks of the Râul Alb and at the confluence with its tributaries the pastures (included within *Agrostio - Deschampsietum caespitosae*) are dominated by tussock grass and by *Agrostis stolonifera*. In areas with higher humidity, small communities occur where the bulrush prevails.

On the tributaries of the Râul Alb River located in the studied area there are found small areas of mesotrophic swamps with low acidity, that host communities (*Junco-Caricetum fuscae*) dominated by bulrush and sedge species (especially *Juncus articulatus* and *Carex nigra*).

The sources from the spruce forests are colonized by the skiaphyte communities prevailed by bittercress (*Cardamine amara*) and golden-saxifrage.

In the upper part of the Cepelor Valley, on an area of a few tens of square meters, typical oligotrophic swamps, with communities that belong to the association *Carici echinatae-Sphagnetum,* dominated by peat moss accompanied by several highly acidophilous bulrush species.

At the source of the Cepelor Valley, in the area of nivo-glacial relief existing here and in the curvature of the Piatra Grăitoare crest, there are present coenoses (*Swertio punctatae-Saxifragetum stellaris*) typical for mountainous sources, dominated by kingcup, by some hygrophilic *Saxifraga* species and by *Swertia punctata.*

The rock vegetation is scantly represented in the studied area. The more humid scree areas are covered by woody vegetation, but the dry ones mostly lack vascular plants. As regards the rockeries, they are found at the source of Cepelor Valley and in the Piatra Grăitoare Peak area. Especially in the latter location there were found fragments of rock communities belonging to *Asplenietum septentrionali-adianti-nigri*, hosting several *Asplenium* species.

Chapter III The description of present vegetation

3.1. Research and mapping methods

3.1.1. Research methods

The main purpose of our research was the unitary and detailed characterization of the Biharia Massif vegetation and of its adjacent areas, towards the East to the Arieşul Mare and towards the South until the Arieşul Mic River. As the floristic and phytocoenotic data published in this area are few and erratic, the approach could not be but inductive, through a descriptive research (Kent *et* Coker, 1992).

The field research for the characterization of the natural and semi-natural vegetation installed on the upper interfluve of the two Arieş Rivers was conducted between 2006-2012, during the vegetation period, especially in the June-September interval. We have focused our research mainly upon areas with natural vegetation, specific to the studied territory, and only secondary we have studied anthropophyllous vegetation, especially within mesophyllous pastures.

Before the conduct of the field studies, a preparatory phase was developed. In this regard, a literature review was performed that included the study of the cartographical material referring to the region of interest and the assimilation of the flora and vegetation papers published on the respective area. Also, the consultation of the database from the Herbarium of "Al. Borza" Botanical Garden of Cluj-Napoca was performed.

In the sampling phase we have attempted to cover an as large as possible range of geomorphologic variability. The sampling areas were selected so that they included to a large extent the macro-topography, the altitude variations existing within the territory and the mezo-topography, but for a proper characterization and classification of phytocoenoses into associations, the study also considered the (subjective) criteria of ensuring the homogeneity of habitats and stationary conditions: avoidance of ecotones and phytocoenoses in various dynamic ephemeral stages or anthropogenically degenerated (Cristea *et al.*, 2004).

The sizes of the sample areas were established based on the literature recommendations for these vegetation formations (Cristea *et al.*, 2004), (Cristea, 1991, 1993), (Kovács, 1979). The inventory periods were the periods of maximum phytocoenoses development (Cristea *et al.*, 2004).

In each type of vegetation, phytosociological relevés were carried out according to the Central-European School protocol (the Braun-Blanquet method) following the recommendations from the specific literature (Braun-Blanquet, 1964) (Borza *et* Boşcaiu,

1965),(Cristea *et al.*, 2004), (Cristea, 1991, 1993). For each relevé, the corresponding geographical coordinates were recorded in the field by a Garmin 60 GPS device.

The environmental variables recorded for each phytosociological relevé were: the altitude, the exposition, the slope, the size of the sampling area, the general cover of vegetation, the cover of various forest vegetation layers and the land use.

For each inventory unit, the quantitative presence of the cormophytes was estimated by their relative percentage cover, expressed on the Braun-Blanquet and Pavillard scale, modified and completed by Tüxen and Ellenberg (Cristea *et al.*, 2004).

Species determination was performed in the field but also in the laboratory, based on the herbarium collected material, especially for taxa displaying identification difficulties (Jávorka and Csapody, 1975), (*** 1952 -1976), (Ciocârlan, 2009) and (Prodan, 1939).

In the thesis completion phase, by courtesy of Mr. Crăciun Olaru, who conducted studies in this area during the '70s, several papers were made available to us (Olaru, 1979, 1980, 1981), as well as a series of field data very useful especially for the characterisation of spruces and mixed forests, where the natural, compact structure areas are very difficult to find at present. A large part of these data were published, with the author's consent, together with our field data, completing the latter (Ursu and Olaru, 2010).

Within the synthetic phase (Cristea *et al.*, 2004), the relevés were recorded in database using the TURBOVEG programme (Hennekens, 2001).

The data collected during this period were gathered in a database composed of 405 relevés. Among these, only 247 (of which 131 conducted by us) were classified in terms of coenotaxonomy (especially after Coldea *et al.*, 1991, 1997), the others with a high degree of similarity or presenting an atypical structure, which has not enabled their classification according to the classical coenotaxonomic criteria, so that they could only be used for their floristic and chorologic value.

Therefore, a computer-based classification process was approached on the entire database using the Ginkgo multivariate analysis software (De Cáceres *et al.*, 2007). This would enable an alternative classification comparable with the classical one. Nevertheless, the tested variant did not provide relevant results, and the testing of other options will be necessary in the future to achieve the proposed result.

The coenotaxonomic classification was conducted based on the synthesis papers written on the vegetation of Romania (Coldea, 1991), (Sanda *et al.*, 1997), (Sanda, 2002), (Sanda *et al.*, 1999), referring also to the *Code of Phytosociological Nomenclature* (Weber *et al.*, 2000).

The final processing of the phytosociological tables for each association was performed by means of the Excel programme. The vertical ordering of species was conducted by the coenotaxonomic criteria, and within the coenotic groups the species were ordered from the top to the bottom in reverse proportion with their constancy.

Among the phytocoenotic indices, the constancy of species (K) was calculated for the associations represented by a minimum number of 5 relevés. The associations represented by 3-4 relevés were presented in tables but without calculating their constancy, while those represented by only 1-2 relevés were presented as text.

For the characterisation of each association, the same system was applied, presenting first the general considerations on its distribution and ecological character, followed by the analysis of the aspects that are specific to the phytocoenoses of the association from the studied area.

The analysis of the coenotaxonomic and ecologic plant categories for these communities was performed, using the ecological indices (UTRNL) described by Ellenberg (Ellenberg, 1979), (Ellenberg *et al.*, 1991) for the plants in the Central Europe. For a better visualization, the spectrum of the ecological categories presence was generated for each association. In the end, the association chorology within the studied area was presented, as well as some syndynamic and land use aspects.

3.1.2. Mapping methods

In order to bring a note of modernity to our research, but also to analyze and present the data more efficiently, we also assumed the task of drawing a real vegetation map of the studied area, at alliance level, by using the satellite images and the Geographic Information System (G.I.S.) (Cristea *et al.*, 2004).

The map was performed at a 1: 20000 scale, using in this regard color good resolution satellite images available for free (Google Earth) and the ArcGIS 9.3.1. (47) programme, made available by courtesy of I.C.B. Cluj-Napoca.

By manual vectorization in GIS, about 1100 vegetation polygons were created. For some of these, the type of vegetation was detectable on the satellite image but for others, the certain classification was possible only in the field, when we also checked the correctness of the framing for the polygons plotted by using the satellite image.

Subsequently, each polygon was associated information related to the type of vegetation, alliance and occupied area.

3.2. The conspectus of associations identified in the studied area

ASPLENIETEA RUPESTRIS Br.-Bl. 34

ANDROSACETALIA VANDELII Br.-Bl. 1934

Asplenion septentrionalis Oberdorfer 1938

*1. Asplenietum septentrionali-adianti-nigri*Oberd. 1938

JUNCETEA TRIFIDI Klika *et* Hadač 1944

CARICETALIA CURVULAE Br.-BI. 1926

Caricion curvulae Br.-BI. 1925

*2. Potentillo ternatae-Festucetum airoidis*Boscaiu 1971

Loiseleurio-Vaccinion Br.-Bl. 1926

*3. Empetro-Vaccinietum gaultherioidis*Br.-Bl. 1926

vaccinietosum vitis-idaeae Coldea 1991

CALLUNO-ULICETEA Br.-Bl. *et* Tüxen ex Klika *et* Hadač 1944

NARDETALIA Oberd. ex Preising. 1949

Potentillo-Nardion Simon 1957

4. Scorzonero roseae-Festucetum nigrescentis (Puşcaru *et al.* 1956) Coldea 1987

5. Violo declinatae-Nardetum Simon 1966

Violion caninae Schwickerath 1944

6. Polygalo-Nardetum strictae Oberd. 1957

VACCINIO – GENISTETALIASchubert 1960

Genistion pilosae Duv. 1942 em. Schubert 1960

7. Vaccinio-Callunetum vulgaris Bük 1942

8. Bruckenthalio-Vaccinietum Coldea 2008

MONTIO-CARDAMINETEA Br.-Bl *et* Tx. 1943

MONTIO-CARDAMINETALIA Pawl. 1928

Cardamino-Montion Br.-Bl. 1925

9. Chrysosplenio-Cardaminetum amarae Mass. 1959

10. Philonotido-Calthetum laetae (Krajina 1933) Coldea 1991

11. Swertio punctatae-Saxifragetum stellaris Coldea (1995-1996)1997

SCHEUCHZERIO-CARICETEA NIGRAE (Nordh. 1937) Tx. 1937

CARICETALIA NIGRAE Koch 1926 em. Nordh. 1937

Caricion nigrae Koch 1926 em. Klika 1934

12. Junco-Caricetum fuscae Tx. (1937) 1952

13. Sphagno-Caricetum rostratae Steffen 1931

14. Carici echinatae-Sphagnetum Soó (1934) 1954

BETULO-ADENOSTYLETEA Br.-Bl. *et* Tx. 1943

ADENOSTYLETALIA Br.-Bl. 1931

Adenostylion alliariae Br.-Bl. 1925

15. Adenostylo-Doronicetum austriaci Horv. 1956

16. Salici-Alnetum viridis Colič *et al.* 1962

Calamagrostion villosae Pawl. 1928

17. Phleo alpini-Deschampsietum caespitosae (Krajina 1933) Coldea 1983

PHRAGMITETEA Tx. *et* Prsg. 1942

PHRAGMITETALIA W. Koch 1926

Phragmition W. Koch 1926

18. Glycerio-Sparganietum neglecti Koch 1926 em. Phillippi 1973

MOLINIO - ARRHENATHERETEA R. Tx. 1937

ARRHENATHERETALIA Pawlowski 1928

Cynosurion cristati R. Tx. 1947

*19. Anthoxantho-Agrostietum capillaris*Sillinger 1933 em. Jurko 1969

20. Festuco rubrae-Agrostietum tenuis (*capillaris*) Horvat 1951

MOLINIETALIA W. Koch 1926

Deschampsion caespitosae (Horvatić 1930) Soó 1971

21. Agrostio stoloniferae-Deschampsietum caespitosae Ujvárosi 1947

Calthion palustris Tx. 1937

22. Scirpetum sylvatici Maloch 1935 em. Schwick. 1944

23. Epilobio-Juncetum effusi Oberd. 1957

Filipendulion ulmariae Segal 1966

24. Telekio-Filipenduletum ulmariae Coldea 1996

EPILOBIETEA AUGUSTIFOLII Tx. *et* Prsg. in Tx. 1950

ATROPETALIA Vlieg. 1937

Epilobion angustifolii (Rübel 1933) Soó 1933

25. Senecio sylvatici-Epilobietum angustifolii (Heck 1931) Tx. 1950

Sambuco-Salicion Tx. 1950

26.Sambucetum racemosae (Noirf. 1949) Oberd. 1973

27. Rubetum idaei Pfeiff. 1936 em. Oberd. 1973

28. Sorbo-Betuletum pendulae Dihoru 1975

QUERCO-FAGETEA Br.-Bl. *et* Vlieger 1937 emend. Soó 1964

FAGETALIA SYLVATICAE Pawl. 1928

Symphyto-Fagion Vida 1959

Symphyto-Fagenion (Vida 1959) Soó 1964

29. Symphyto cordati-Fagetum sylvaticae Vida 1959,

30. Leucanthemo waldsteinii-Fagetum (Soó 1964) Täuber 1987

Calamagrostio-Fagenion Boşcaiu *et al.* 1982

31. Hieracio rotundati-Fagetum (Vida 1963) Täuber 1987

Alno-Ulmion Br.-Bl. *et* Tx. 1943 em. Müll. *et* Görs 1958

32. Telekio speciosae-Alnetum incanae Coldea (1986) 1990

VACCINIO-PICEETEA Br.-Bl. 1939

VACCINIO-PICEETALIA Br.-Bl. 1939

Piceion abietis Pawl. in Pawl. *et al.* 1928

Soldanello majori-Picenion Coldea 1991

33. Hieracio rotundati-Piceetum Pawl. *et* Br.-Bl. 1939

34. Hieracio rotundati-Abietetum (Borhidi 1971) Coldea 1991

35. Soldanello majori-Piceetum Coldea *et* Wagner 1998

36. Leucanthemo waldsteinii-Piceetum Krajina 1933

37. Sphagno-Piceetum (Tx. 1937) Hartman 1942

Pinion mugo Pawl. 1928

38. Vaccinio myrtilli - Pinetum mugo Hadač 1956

39. Campanulo abietinae-Juniperetum Simon 1966

40. Campanulo abietinae-Vaccinietum (Buia *et al.* 1962) Boşcaiu 1971

3.4. The present vegetation map

In case of the area chosen for study, one can notice (fig. 3.30) the dominance of phytocoenoses classified in the *Piceion abietis* alliance. Although these forests present generally a spatial continuity, they occur as a mosaic of more compact areas (usually with young trees, under the age of logging), alternating with mature, but thinned forests, and with clearings. More compact forests are found at higher altitudes (towards the upper forest limit) and on the steep slopes.

Especially in the Southern part of the territory, towards the Arieşul Mic River, but also in its Eastern area, the beech forests and mixed forests dominated by beech are prevailing, classified in the *Symphyto-Fagion* alliance. Especially at lower altitudes, they have a fragmented aspect, as the pedoclimatic conditions more favorable to agriculture in

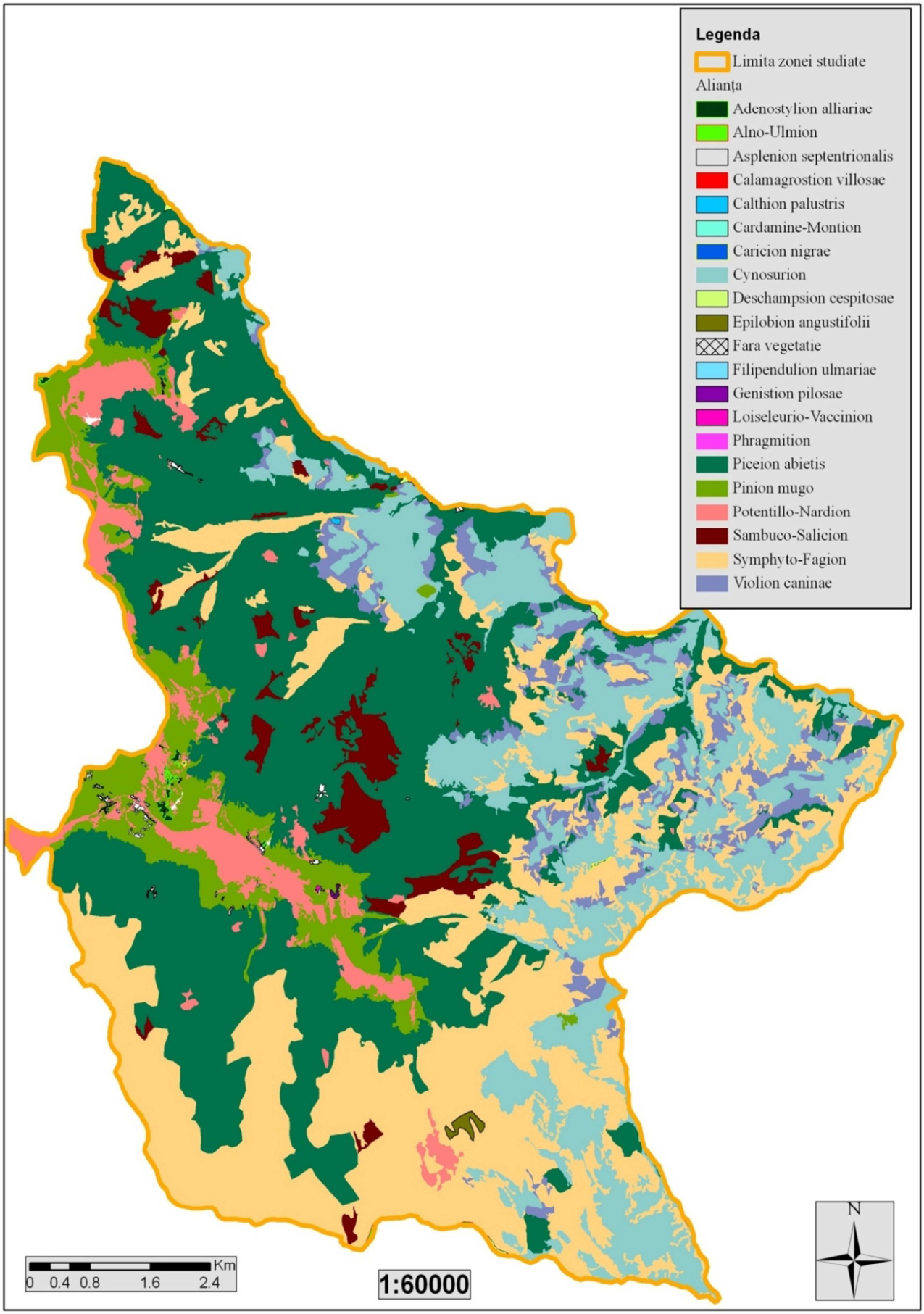

Fig. 3.30. Present vegetation map of the studied area

these areas determine the establishment of households and agricultural lands in the areas of cleared beech forests. At present, the coenoses of this alliance cover approx. 2340 ha.

The anthropogenic areas are represented by households surrounded by agricultural lands. Following the agricultural crops, grass communities included in the *Cynosurion* alliance develop on these lands, which are used as pastures and grasslands. After a few years, they are abandoned and the vigor of plants decreases in the absence of fertilization. They are replaced by the coenoses of the *Violion caninae* alliance, with low nitrogen requirements, specific to the high acidity soils. This syndynamic process is described in more detail in the section dedicated to pasture vegetation.

The high area of the Biharia Massif is, with few exceptions, populated by shrubs included in the *Pinion mugo* alliance represented mainly by coenoses dominated by juniper, and to a lower extent by blueberries. Only insularly in the nivo-glacial cirque from the Cepelor Valley source, mountain pine coenoses are found. On small areas in the massif crest, and on the highest peaks there are found fragments of subalpine coenoses included in the *Caricion curvulae* and *Loiseleurio-Vaccinion* alliances. On approx. 400 ha, the subalpine shrubs were cleared and in their place, the herbaceous coenoses classified in the *Potentillo-Nardion* alliance have installed.

The coenoses corresponding to the other alliances identified in the studied territory develop on low areas and are difficult to detect at the vegetation map scale.

Chapter IV. The analysis of the Natura 2000 habitats in the study area

4.1. The presentation method of the habitat analysis

The European Network Natura 2000 includes areas that comprise a representative sample of species and habitats whose protection and conservation is of the greatest interest in the EU.

During the last 5 years, in the Biharia Massif there were appointed two Natura 2000 sites (ROSCI0260 – Cepelor Valley and ROSCI324 - Bihor Mountains). The first of these sites is included in the area of our researches, and the second overlaps only partially the studied area.

The present chapter addresses the practical need for knowledge of the spatial distribution and surface occupied in the studied area by the Natura 2000 habitats for which these sites were assigned. The correlation of information from standard forms of these sites (mainly from literature) with the data achieved in the field is also necessary.

The correspondence between the types of phytocoenoses found here and the types of Natura 2000 habitats was performed based on the existing specialty literature (Doniță *et al.*,

2005), (Gafta and Mountford, 2008). Therefore, for each **type of habitat of Community importance considered significant,** the following elements were indicated:

- the Natura 2000 code, the name and description of the Natura 2000 habitat type where the identified vegetation associations may be classified;
- the code, name and description of the Romanian habitat type where the identified vegetation associations may be classified;
- the area occupied by the type of habitat of Community importance from the studied area.
- the map of spatial distribution of the N2000 habitat type within the entire studied area.

It was considered that the simple presence of some plant species indicated in the Interpretation Manual of European Union Habitats to be important for the characterization and identification of some types of habitats, does not necessarily involve the existence in the field of the corresponding habitats. Generally, **the recognition species should be integrated in clearly shaped biocoenoses, whose synecology reflects the abiotic conditions of the respective habitat** (Gafta and Mountford, 2008)

4.2. The classification of identified associations within the Natura 2000 habitat types

4.2.1. General aspects

The names of the Community and priority interest habitats in the Natura 2000 **ROSCI0324 Bihor Mountains** and **ROSCI0260 Cepelor Valley** sites, which partially overlap the area subjected to study in this PhD thesis, and their correspondence with the national habitats are taken from the interpretation manuals of the Natura 2000 habitats (EUR 27; Doniță *et al.*, 2005; Gafta and Mountford, 2008).

We mention that we did not find all the habitats listed in the standard forms of these two Natura 2000 sites in the studied area and that other habitats of Community interest were noticed, that we will present together with their correspondents in the Romanian habitats. We have also identified habitats of national interest (acc. to Doniță *et al.*, 2005) which have no correspondent in the Natura 2000 habitats of Community interest.

4.2.2. The analysis of the existing information in the Natura 2000 Standard Forms of the 2 sites

A. ROSCI0324 Bihor Mountains

In the **standard form** of the Natura 2000 ROSCI0324 Bihor Mountains site there are 6 habitats of Community interest described, of which one is of priority interest, as follows: 9170 *Galio-Carpinetum* oak – hornbeam forests; 9130 *Asperulo-Fagetum* beech forests; 91V0 Dacian beech forests (*Symphyto-Fagion*); 9110 *Luzulo-Fagetum* beech forests; 9410 Acidophilous *Picea*

forests of the montane to alpine level (*Vaccinio-Piceetea*); 4070 * Bushes with *Pinus mugo* and *Rhododendron hirsutum*

Among these habitats, **in the area subjected to study within this PhD thesis there were identified** 4 habitats, as follows: 9410 Acidophilous *Picea* forests of the montane to alpine level (*Vaccinio-Piceetea*); 91V0 Dacian beech forests (*Symphyto-Fagion*); 9110 *Luzulo-Fagetum* beech forests; 4070 * Bushes with *Pinus mugo* and *Rhododendron hirsutum.*

However, among these, only the first two are in the section from the studied area included in the Bihor Mountains site, as the mountain pine shrubs in the studied area are completely included in the Cepelor Valley site. Also, we noticed the habitat 9110 *Luzulo-Fagetum* beech forests in the studied area outside the boundaries of the Bihor Mountains site.

We did not find in the studied area two of the habitats mentioned in the Standard Form for the Natura 2000 ROSCI0324 Bihor Mountains site, i.e. 9170 Oak and hornbeam forests of the *Galio-Carpinetum* type, 9130 Beech forests of the *Asperulo-Fagetum* type.

The first is specific to lower altitudes; the minimum altitude within the studied area is approx. 760 m. Neither *Carpinus betulus,* nor *Quercus* species were mentioned within the studied area by the authors who conducted researches here and we did not notice them either.

The habitat 9130 Beech forests of the *Asperulo-Fagetum* type is specific, by all its subtypes, to neutrophilic forests, while the substrate of the studied area is almost without exception composed of rocks and implicitly soils that are acid or very acid. Even if some species mentioned in this habitat, such as *Galium odoratum* or *Galium schultesii* were found erratically in the beech forests from the studied area, they are accompanied by numerous acidophilous species which reveal us the type of the substrate in the area.

B. ROSCI0260 Cepelor Valley

In the **standard form** of the Natura 2000 ROSCI0260 Cepelor Valley site there is a number of 8 habitats of Community interest, of which two of priority interest, as follows: 6230 * Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas; 4060 Alpine and boreal heaths; 4070 * Bushes with *Pinus mugo* and *Rhododendron hirsutum*; 3220 Alpine rivers and the herbaceous vegetation along their banks; 9410 Acidophilous *Picea* forests of the montane to alpine level (*Vaccinio-Piceetea*); 9110 *Luzulo-Fagetum* beech forests; 6510 Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*); 8110 Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*).

From these habitats listed in the Natura 2000 site, 6 habitats were identified in the studied area of the PhD thesis, as follows: 6230 * Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas; 4060 Alpine and boreal heaths; 4070 * Bushes with *Pinus mugo* and

Rhododendron hirsutum; 3220 Alpine rivers and the herbaceous vegetation along their banks; 9410 Acidophilous *Picea* forests of the montane to alpine level (*Vaccinio-Piceetea*); 9110 *Luzulo-Fagetum* beech forests.

We did not find in the studied area two of the habitats mentioned in the Standard Form for the 2000 ROSCI0260 Cepelor Valley site, namely 6510 Low altitude pastures (*Alopecurus pratensis, Sanguisorba officinalis*) and 8110 Siliceous debris from the montane to the alpine zone (*Androsacetalia alpinae* and *Galeopsietalia ladani*).

In case of the first habitat, although the species *Alopecurus pratensis* was noticed in several points, it is not abundant and does not form the vegetation specific to this type of habitat. Also, this habitat is specific to the plain area up to the sub-montane zone, while the studied area includes in its lowest area only the upper part of the middle sub-montane zone.

Regarding the siliceous debris habitat, from our field observations, the humid debris is covered by wood vegetation, the dry debris mostly lack vascular plants, the rocks being covered with crusty lichens. The scree patches in the crest area are surrounded by juniper and blueberry shrubs, but there is no vegetation specific to this type of habitat.

We consider that habitat 9110 *Luzulo-Fagetum* beech forests, although noticed in the studied area, is not present within the boundaries of the Natura 2000 Cepelor Valley site, whose forest vegetation, even in its lower part (around 1200 m) is composed of mixed forests dominated by spruce.

4.2.3. The classification of identified phytocoenoses within the Natura 2000 habitats

The Natura 2000 habitats identified in the studied area (according to Gafta and Mountford, 2008), present also in the standard forms of the two sites are the following: 9410 Acidophilous *Picea* forests of the montane to alpine level (*Vaccinio-Piceetea*)**;** 91V0 Dacian beech forests (*Symphyto-Fagion*)**;** 9110 *Luzulo-Fagetum* beech forests**; 4070 *** Bushes with *Pinus mugo* and *Rhododendron hirsutum**;*** **6230 *** Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas**; 4060** Alpine and boreal heaths**; 3220** Alpine rivers and the herbaceous vegetation along their banks**.**

Besides the habitats listed in the standard forms of the mentioned Natura 2000 sites, we have identified 10 Natura 2000 habitats of Community interest (of which two are of priority interest), as follows: **8220 Siliceous rocky slopes with chasmophytic vegetation; 6150 Siliceous alpine and boreal grasslands; 4030 European dry heaths; 7140 Transition mires and quaking bogs; 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels; 4080 Sub-arctic *Salix* spp. scrub; 6520 Mountain hay meadows; 6440 Alluvial meadows of river valleys of the *Cnidion dubii*; 91E0* Alluvial forests with**

Alnus glutinosa **and** ***Fraxinus excelsior*** **(*Alno-Padion, Alnion incanae, Salicion albae*); 91D0* Bog woodland.**

Of these, we consider **only 5 (8220, 6150, 4080, 6520 and 91D0*)** to be significant for the studied area; although all the corresponding communities were described within the description of the associations, due to the fact that are found on very small areas, the remaining 5 are not considered representative as habitats.

In addition to the habitats of community/priority interest presented so far, 4 habitats of national interest were identified in the studied area, with no Natura 2000 correspondent, as follows: **R5421 South-Eastern Carpathian communities of sources and rivulets with *Chrysosplenium alternifolium* and *Cardamine amara;* R5411 South-Eastern Carpathian eu-mesotrophic swamps with *Carex nigra* ssp. *nigra*, *Juncus glaucus* and *Juncus effusus;* R5410 South-Eastern Carpathian mesotrophic swamps with *Carex echinata* and *Sphagnum recurvum*; R3113 South-Eastern Carpathian red elderberry scrubs (*Sambucus racemosa*).**

The corresponding communities of these types of habitats have also a very low cover in the studied area, so that we do not consider them to be representative as habitats.

4.3. The spatial distribution of the types of habitats

In order to have a general view on the habitats of Community/priority interest considered to be significant for the studied area, the present PhD thesis describes (tab. 4.1.) the areas they cover, while fig. 4.2. and 4.3 within the thesis present the arrangement of the Natura 2000 habitats considered to be significant within the studied area, respectively the overlap of the two Natura 2000 sites mentioned above with the studied area.

4.4. The conservation value and proposals

Generally, the conservation value of habitats is high either due to the species they shelter or to the small areas that they cover, respectively of their low presence/absence at European level.

The specialty literature (Doniță *et al.*, 2005) mentions the following conservation value of the habitats considered to be significant for the studied area:

- of very high conservation value: **R4209, R4212**, **R4103, R4210, R3109.**
- of high conservation value: **R4203, R3105, R4109, R3108, R6219,R3604**.
- of moderate conservation value: **R4206, R3609, R3110, R3804.**
- of low conservation value: **R3111, R5416, R3803.**

Proposals:

We consider that the alteration of the ROSCI0260 Cepelor Valley site boundaries is necessary to include the area of forested peat bog area included in habitat 91D0*

The arguments in favor of this proposal are the following:

- habitat 91D0* is considered a priority
- the peat bog area is relatively large: 6.4 ha
- it is adjacent to the border of the site, and the inclusion of an intermediate area is not necessary
- this surface has no economic utility, so its inclusion in the protected area would not generate conflicts with potential stakeholders
- the conservation condition of the habitat is favorable

We also consider suited the inclusion in the list of protected habitats for the two sites, of those habitats with high conservation value and significant surface that have been noticed within their boundaries, as follows:

For the Bihorului Mountains site:

-The rock communities in the Cornul Berbecului area

-The area with mountain alder located near the Piatra Grăitoare Peak

-The northern bilberry and *Festuca airoides* communities on the Cucurbăta Mare Peak

-The spring communities from the curvature of the Piatra Grăitoare crest

For the Cepelor Valley site

- The northern bilberry and *Festuca airoides* communities on the Cucurbăta Mică Peak

The protection of these habitats would require at least the display of some informative panels for tourist awareness on the presence, peculiarity and necessity to protect these phytocoenoses.

Chapter V. Floristic considerations

5.1. The analysis of the ecological indices of the flora in the studied area

The 5 ecological indices suggest (fig. 5.1) the mesophilic (U5=29,16%), micro-mezothermal (T5=23,16%), weakly acid-neutrophilic (R7= 19,89%), weakly nitrophylic (N2= 19,35%) and semi-heliophilic (L7= 29,4%) character of the regions cormoflora.

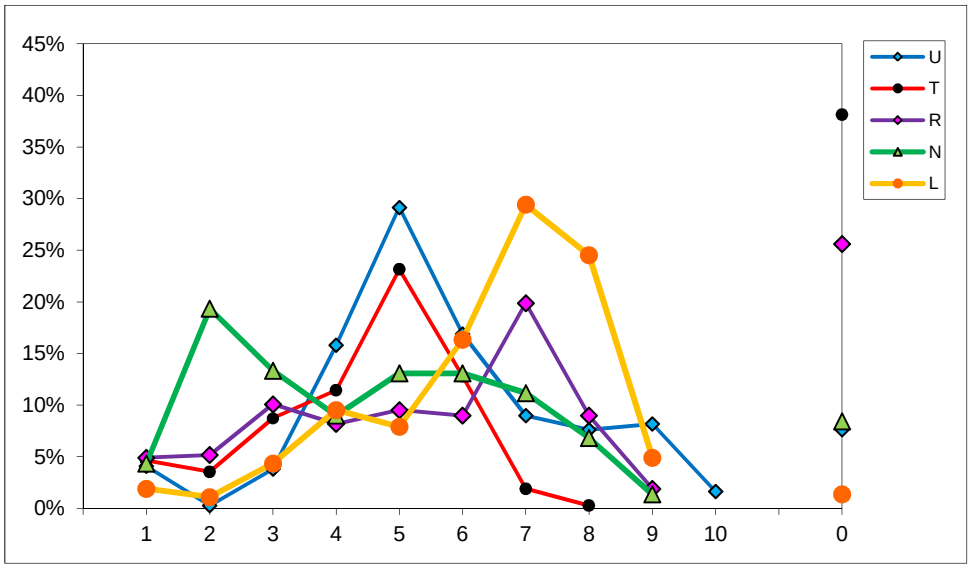

Fig. 5.1: The spectre of ecological cathegories for the flora of the studied territory

Conclusively, one might appreciate that from the ecological point of view, the flora of the studied area has an evident montane character which allows for the growth of spontaneous plants adapted to this climate. From those that are cultivated, only the micro-mezothermal species achieve optimum growth, provided that fertilization is applied.

5.2. Consideration on the floristic list

Based on the published data, on herbarium data, on certain unpublished field data and on the personal observations, we have performed a synthesis embodied in the floristic list of the cormophites taxa observed in the studied area, which includes 538 taxa, discussed into mare details within the PhD thesis.

The floristic conspectus (Annex 1 of the PhD thesis) includes a list of all the taxa clearly mentioned in the information sources and referenced literature to be present in the studied area, or observed by us during the field studies. As some references are very old (Kerner, 1867-1879), (Simonkai, 1886), we have tried to update as much as we could, the names of the taxa in compliance with Flora Europaea (17), (Tutin *et al.*, 1964-1980).

The description of the taxa was performed in alphabetical order, each taxa being associated the information sources mentioning it for the studied area.

CONCLUSIONS

- Very diverse plant communities were identified, belonging to **40 associations, 21 alliances, 13 orders and 11 vegetation classes**. Among the 40 associations, **26 a new for the studied region.**
- **A database including 405 relevés** was created, of these relevés 247 were coenotaxonomically classified. Of these, **131 are original relevés.**
- The vegetation associations were described and **analyzed** in terms of **coenotaxonomy and ecology,** and where this was appropriate, the **sin-dynamic aspects** were discussed. For each association represented by at least 3 relevés, **the spectrum of the ecological categories** was developed and the **analytic table** of the association was described. For most of the associations, the **area occupied within the studied territory** was also relatively precisely estimated.
- **A GIS database** was created comprising over **1100 vegetation polygons** which have been **classified into types of vegetation, alliances and Natura 2000 habitats**.
- The following **GIS maps** were developed:

-the map of the general aspect of vegetation, scale 1:60000

- the present vegetation map at alliance level, scale 1:20000

- the map of the Natura 2000 habitats significant for the studied area, scale 1: 40000

- the map of the Natura 2000 sites overlapping the studied area, scale 1: 40000

- **17 Natura 2000 habitats** were identified, of which:

-7 are mentioned in the standard forms of the Natura 2000 sites crossing the studied area

-10 Natura 2000 habitats are new for the studied area.

- all in all, of the 17 identified habitats**, 12 were considered representative** for the studied area, as follows: **9410; 4070*; 91V0; 9110; 6230*; 4060; 3220; 8220; 6150; 4080; 6520; 91D0* and their area was estimated.**
- of these, **3 are habitats of Natura 2000 priority.**

- The 12 Natura 2000 habitats correspond to **18 types of national habitats** considered by the experts, in terms of their conservation value, as follows:

- 5 have a very high conservation value

- 6 have a high conservation value

- 4 have a moderate conservation value

- 3 have a low conservation value

- **4 habitats of national interest without correspondence** in the Natura 2000 habitats of Community interest were identified (**R3113, R5410, R5411, R5421**)

- **The alteration of the Natura 2000 Cepelor Valley site boundaries** was proposed to include a contiguous **surface of approx. 6 ha of Natura 2000 priority habitat 91D0*,**
- The floristic list of the cormophytes in the studied areas was compiled from **1870 until present time**, mentioning **the data source for each taxon.**
- The list includes **538 taxa,** of which we have **observed in the field 403 taxa**. Of these, **61 are new for the studied area,** while **7 taxa** we found after approx. **140 years since their literature citation**.

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- GIS Maps
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- România

Published papers, concerning the thematic of the thesis

1. Ursu, T., Coldea, G. (2007). Contributions to the flora of the Biharia Massif (Romania). *Contrib. Bot.,* 19-26.

2. Ursu, T., Olaru, C. (2010). The vegetation of the Biharia Massif (Apuseni Mountains) - General characterization. *Contrib. Bot.*,XLV, 25-33.