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Grădina Botanică "Alexandru Borza"
Cluj-Napoca

THE VEGETATION OF THE NATURAL RESERVE VALEA FAGILOR – LUNCAVIŢA (TULCEA COUNTY, ROMANIA)

Adrian OPREA[1], Culiţă SÎRBU[2], Irina GOIA[3]
[1] Grădina Botanică "Anastasie Fătu", str. Dumbrava Roşie, nr. 7-9, **RO-700487 Iaşi, Romania**
[2] Universitatea de Ştiinţe Agricole şi Medicină Veterinară, str. M. Sadoveanu, nr. 1, **RO-700490 Iaşi, România**
[3] Universitatea Babeş-Bolyai, Facultatea de Biologie şi Geologie, Catedra de Taxonomie şi Ecologie, str. Republicii, nr. 42, **RO-400015 Cluj-Napoca, România**
e-mail: a_aoprea@yahoo.co.uk

Abstract: Our study is an attempt to complete the description of a particular, isolated type of natural habitat (sensu Habitats Directive 92/43/EEC): 91X0* *Dobrogean beech forests*, already described in the *Interpretation Manual of European Union Habitats – EUR27*, distributed only in a forest reserve in Dobrogea (Romania).

The importance of this forest reserve is the existence here, in its only refuge in Dobrogea, of a beech outlier, situated far away from other beech woodlands, either in the bend of the sub-Carpathians or in the Central Moldavian Plateau, the closest regions associated with these forest types. However, the existence of this beech forest has led to the description of a particular, priority habitat for conservation in the European Union.

The vascular flora of the Valea Fagilor forest includes some plants rare in Romania, as well as in the flora of Dobrogea, such as: *Doronicum hungaricum*, *D. orientale*, *Galanthus plicatus*, *Lathyrus aureus*, *Myrrhoides nodosa*, *Nectaroscordum siculum* subsp. *bulgaricum*, *Smyrnium perfoliatum*, *Symphytum tauricum*, etc.

Based on these characteristic species, as well as the presence of *Fagus taurica* as a dominant species in the tree layer, a new plant association is here described and typified: *Symphyto taurici–Fagetum taurici* ass. nova.

This study also shows that the Dobrogean beech stand does not include either species characteristic of the Carpathian beech forests, or of the Central Moldavian Plateau, but some southern and eastern floristic elements are present, thus giving it special features.

Keywords: beech forest, diversity conservation, Dobrogea, Habitat Directive 92/43/EEC, new plant association, Romania.

Introduction

Beech forests in Romania are denoted in the extent of the European beech forests as a special element, giving them the character of a phytogeographical and syntaxonomic entity. Due to the fact that they were formed at the climatic junction of Central-East and South Europe, this gives them a distinctive ecological form and a higher capacity for coenotic integration [10].

The upper limit of beech in Romania is around 1300 m a.s.l. in the Eastern Carpathians, 1360 a.s.l. m in Southern Carpathians, and 1400 m a.s.l. in Banat Mountains (sometimes, even 1500 m a.s.l.). The lower limits vary between 300 and 600 m a.s.l.; often, beech trees descend into the hilly regions down to 150-200 m a.s.l., in clusters or as isolated trees, most of the time on northern slopes or along narrow valleys. The lowest points with beech trees are: the Danube valley at Orşova and Moldova Nouă (at 60 m a.s.l.), Bucovăţ forest (near Craiova), Stârmina forest (at Hinova, near Drobeta Turnu-Severin), Bucoviciorul forest (Dolj county), etc. [3].

The first scientific studies on beech forests in Romania were made by Borza, who communicated his results at the 1930 International Botanical Congress in Cambridge, publishing these in the *Guide of the 6th Phytogeographic International Excursion* [5].

The known distribution of the beech forests in SE Romania results from the first forest map, drawn up by Stănescu [72]. Brândză recorded the beech forests within the botanical regions established by himself [12], and Grecescu placed beech forests within a separate area from his

proposed zoning scheme [47]. The area of the beech forests in SE Romania is more accurately rendered on various forest maps dating from the end of the 19th century and on the first maps covering the whole of Romanian vegetation [63]. Later on, beech forests have been completed on all the vegetation maps for the period since [4, 31, 32, 33, 34, 35, 40, 41, 46, 51, 73, etc.].

The first mentions of presence of the beech trees in Dobrogea was made by Enculescu [40] and Grinţescu [48].

In relation to the Valea Fagilor forest (Dobrogea), the closest localities where beech is naturally distributed, toward the North-West, are in the the bend of the sub-Carpathians [50] and in the Central Moldavian Plateau, in the Buciumeni forest (Tutova Hills), at the boundary with the forest-steppe zone of the Nicoreşti foothills [2], as well as in the Bereşti, Talaşmani, Aldeşti, and Balinteşti forests [70]. Towards the South-West, in Muntenia, beech trees are naturally distributed in Snagov forest (north of Bucharest city). Thus, in a paper from 1927, Petrescu has discussed the presence and origin of the beech trees in that forest [61]. Another paper states that in Snagov forest two beech species, *Fagus orientalis* and *F. sylvatica*, are present but only as a few individuals [65].

According to Enculescu [40] cited by Prodan [64], all the beech trees from the Valea Fagilor forest (Dobrogea) belong to *Fagus sylvatica* L. Conversely, Grinţescu stated the presence of *Fagus orientalis* Lipsky (Oriental or Caucasian beech) only, in that forest [48]; later on, Dumitriu-Tătăranu & Ocskay rejected the presence of *F. orientalis* in Dobrogea, confirming instead the presence of *Fagus taurica* (Crimean beech), as stated elsewhere [27, 38, 53, 69, 71].

Also, we have not identified *Fagus orientalis* trees in our four years of surveys made during the anthesis or the fruiting periods of the beech trees (April-May, 2007–2010; July, 2009). In fact, as shown in many relevant references [3, 27, 53], we can say that there are two beech species in Luncaviţa forest, namely *Fagus taurica* and *Fagus sylvatica*. Other authors quoted the presence of *Fagus* species in other two locations in Dobrogea, namely near Cilic Monastery and in Babadag forest [3, 6, 13, 64], but in both of these last two locations beech trees no longer exist today [27].

In Southern Dobrogea (Bulgaria), the presence of beech trees was reported 20–25 km south of Bazargic (Dobrich, the present-day name) only, on a tributary of the Batavia valley (Batova, the present-day name), in the region so-called of Cadrilater [40, in 45]. Therefore, the beech forest of Luncaviţa (in Northern Dobrogea, Romania), should be considered a true island of vegetation, a remnant of a once vast forest system of ancient times [27].

From the phytosociological point of view, the beech communities from the Valea Fagilor forest were first investigated by Dihoru [27], who published a paper based on a single relevé. Following this author, the beech forest would correspond to a so-called forest type "*Fageto–Carpinetum* with *Carex pilosa*" [27]. Later on, Mititelu *et al*., in a paper also based on a single relevé, assigned the vegetation of the Luncaviţa beech stand to a new syntaxon, namely "*Carpino–Fagetum* A. Paucă 1940 subass. *tilietosum tomentosae* Mititelu *et al*. ‘77" [53]. However, over recent decades, other authors [15, 16, 18, 19, 20, 30] have proved that the association described by Paucă [59] from the Mountains of Codru-Moma (Western Romanian Carpathians), differ obviously from the hornbeam and beech communities from eastern Romania. Our field surveys, made between 2007 and 2010, also revealed that the beech community from the northern part of the Măcin Mountains (particularly, in the Luncaviţa forest) are quite differrent from the beech communities ascribed to Ass. *Carpino–Fagetum* Paucă 1941. The results of our investigations are presented below.

The taxonomy of the genus *Fagus* is not yet fully clarified. Thus, Ciocârlan (2009) has included *F. taurica* under *F. orientalis* [21]. In the revised first volume of *Flora Europaea* [75], *F. taurica*, along with *F. moesiaca*, are considered to be taxa intermediate between *F. sylvatica* subsp. *sylvatica* and *F. orientalis*. The authors of the present paper follow the position of Burduja *et al*. [14], who consider these three taxa (namely, *Fagus sylvatica*, *F. orientalis* and *F.*

taurica) to have distinct morphological features and a somewhat different ecology, as well as different areas of distribution.

Study area. Valea Fagilor forest (also called "Luncaviţa" forest in some references) is a nature reserve, denominated as a genetic resource for beech, as well as a natural monument [55]. At the same time, the existence of that beech forest led to the description of a particular "Natura 2000" habitat type, namely 91X0* *Dobrogean beech forests*, which is a priority habitat for conservation in the European Union (accordingly to the Habitats Directive 92/43/EEC, Annex I) [42, 44].

Valea Fagilor forest is situated 10 km South of Luncaviţa village, in the northern part of the Măcin Mountains (Fig. 1), on the North Dobrogean raised fault block, within the limits of a *Natura 2000* site (namely ROSCI0123 Măcin Mountains – the oldest mountains in Romania, and some of the first mountain chains formed on the European continent, as result of the Hercynian orogenesis [1, 56]). The beech stand is between the streams of Luncaviţa (to the North) and Fagilor (to the East), on both sides of a forestry road ("Drumul Leagănului" – in fact, the county road 222 A), *c*. 2 Km upstream from a place called "at Scapeţi", where is situated the forestry ward called "Cetăţuia". The length of this valley is *c*. 1 km, with drainage towards the North, having the flowing point *c*. 1.5 km West of Isaccea town, into a creek called "Gârla Ciulineţu" [1]. The local coordinates of Valea Fagilor forest reserve are: 45° 13′ 8.20″ N / 28° 18′ 32.06 ″ E.

Altitudes range between 96 m a.s.l. (along the "Luncaviţa" valley) and 158 m a.s.l. (at the highest point of the beech forest).

The vegetation zone in which this forest is developed is the Dobrogea forest-steppe, which surrounds the forested massif of Northern Dobrogea [40].

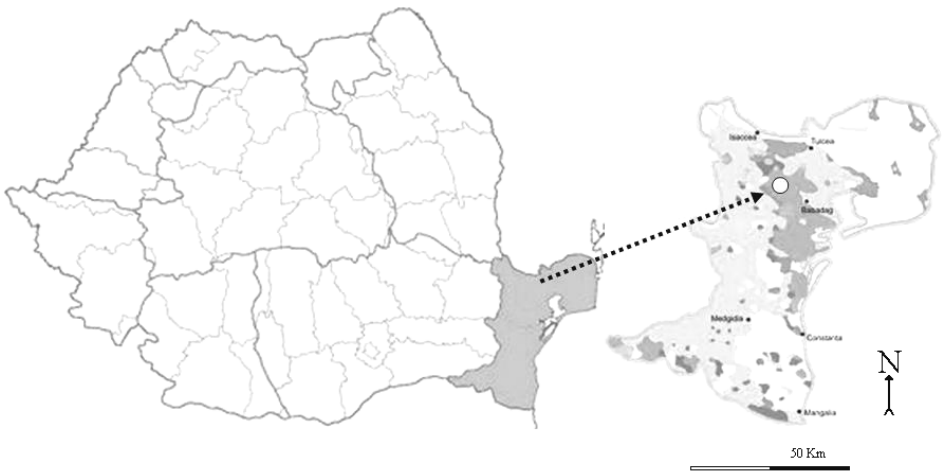

Fig. 1: Geographical location of Valea Fagilor forest reserve in Dobrogea (SE Romania)

The whole surface of the Valea Fagilor forest reserve is 154 ha [78], but the actual area of the beech stand is *c*. 2 ha [1], on the left slope of the same valley; also, some isolated beech trees are located on the right side of the valley [45]. The general aspect of the forest stand is North to North-West.

The geological substrate is represented by Permio-Carboniferous formations (so-called "Carapelit" strata) [1, 56].

The soils identified in the area of the beech stand are brown eu-mesobasic soils, which are formed on loams, gritstones or calcareous conglomerates, with a Ao-Bv-C(R) profile, a variable texture from light to hard, an Ao granular structure, less that 2% humus content, up to 10-12% saturation degree, a *p*H of 5.8-6.5, and a base content that exceeds 55%. Fertility is

increased and favourable to sessile oak and mixed hardwood stands, of superior site class productivity [1, 43]. Other authors state that the soil is a podzol (= luvisoil), of a secondary type [27, 53], deeply and moderately saturated in bases, with a high fertility and high humus content [53].

The general climate in Northern Dobrogea is temperate-continental, with an arid influence, determined by the air-flow circulation from the East; it is characterized by hot, dry summers, long and dry autumns, and very cold winters, with little snow. Due to the dry climate, water flows are reduced, most having seasonal characteristics. Temporary waterflows are made in the rocky valleys during rainy seasons, especially in springtime. This forest-steppe climate type is characterized by an annual average rainfall of 415-500 mm and an annual mean temperature of 10.9 °C [1, 53].

It is well known that forest represents a climax formation for each geographical region, its structure determined by climate. If a particular forest type appears outside of its own historically established zonation, other balancing factors must be involved to give it spatiality and structural stability [66].

Material and Methods

Phytosociological relevés were made between 2007 and 2010, according to the standard Central European phytosociological methodology [7, 11, 23]. Field investigations have been recorded on site. The area of the relevés was 400 m^2.

In each relevé, the following data were recorded: species composition; total coverage in the layers (%), tree height (m) and species abundance-dominance index (AD). After processing recorded relevés through the tabular method [11, 49] a new association was described. The association name is consistent with the *International Code of Phytosociological Nomenclature* [76]. The proportions of life forms and phytogeographical elements (according to Ciocârlan) [21] were calculated, based on species presence. The proportion and average of indexes for light (L), temperature (T), soil moisture (U), and soil reaction (R), was also calculated. All these ecological indexes were used according to Ellenberg *et al*. [39]. The results are discussed against the background of similar investigations of beech communities carried out by other authors [8, 19, 20, 22, 59, 74, 77].

In order to check the individuality of the beech stand from Dobrogea, a comparison with other beech communities from Romania has been carried out based both on classical methods – with special regard to the characteristic plant species, as they are published in the Romanian literature [8, 19, 20, 59, 22, 74, 77] – and by means of statistical methods (hierarchical classification) [62].

Hierarchical analysis has been performed using the SINTAX 5.0 programme [62], the Similarity Ratio Quantitative Index and the Group Average Linkage Algorithm, also known as the Unweighted Pair Group Method Average (UPGMA).

Botanical nomenclature follows Ciocârlan [21]. The life form and floristic elements in Table 1 is given according to Sanda *et al*. [68] and Ciocârlan [21]. The affiliation of the plant species to various syntaxa, as well as higher syntaxa nomenclature, follows Sanda *et al.* [67].

Abbreviations used for the sozological categories of threat follow IUCN criteria [79]. Geographical coordinates were recorded using an eTrex Legend HCx GPS system. Biological and ecological features of the species were noted on the field. Herbarium specimens of *Symphytum tauricum* and *Doronicum orientale*, as well as other plant species collected in the Valea Fagilor forest, are lodged in the Herbarium of the University of Agricultural Sciences and Veterinary Medicine, Iaşi (IASI).

Results

Phytosociological surveys carried out in Valea Fagilor forest reserve, lying in Northern Dobrogea (SE Romania), have led us to describe a new plant association, Ass. *Symphyto taurici–Fagetum taurici* ass. nova. This new association was framed in a syntaxonomical system, as follows:

Class *Querco–Fagetea* Br.-Bl. et Vlieger in Vlieger 1937 (Syn.: *Carpino–Fagetea* Jakucs 1960 (art. 3b); *Carpino–Fagetea* (Br.-Bl. et Vlieger 1937) Jakucs 1960)
Order *Fagetalia sylvaticae* Pawlowski in Pawlowski et al. 1928 (Syn.: *Fagetalia sylvaticae* Pawlowski 1928)
Alliance *Lathyro hallersteinii–Carpinion* Boşcaiu et al. 1982 (Syn.: *Carpinion dacicum* Soó 1962)
Suballiance *Aro orientalis–Carpinenion* (Dobrescu et Kovács 1973) Taüber 1992 (Syn.: *Tilio–Fagion* Dobrescu et Kovács 1973)
Association *Symphyto taurici–Fagetum taurici* ass. nova
Holotype: Table 1, relevé no. 1.

Plant composition and structural characteristics of Ass. *Symphyto taurici–Fagetum taurici* ass. nova, based on 12 relevés, are given in Table 1. Within the relevés analyzed, a total of 103 plant species was recorded, of which 48 (47%) are constant or sub-constant. The number of species per relevé ranged between 33 and 52, with a mean (± standard deviation) of 41 ± 7.0.

The characteristic species of this association are *Fagus taurica*, dominant in the tree layer, and *Symphytum tauricum*, present in the herb layer. The characteristic species for higher syntaxa (sub-alliance, alliance, order, and class) represent *c*. 65% of the plant composition. The other species belong to other classes, such as: *Quercetea pubescentis* (9.6%), *Galio–Urticetea* (9.6%), *Rhamno–Prunetea* (6.7%), or to variae syntaxa (9.6%).

The phytocoenoses are quite dense, with over 90% general coverage. The tree layer, with a height of 15–32 m, and a consistency ranging between 0.7 and 0.9, is dominated by *Fagus taurica*, which is accompanied in some phytocoenoses by *Tilia tomentosa* and *Carpinus betulus*, as co-dominant or subdominant tree species. Other trees, such as *Fagus sylvatica*, *Tilia platyphyllos* subsp. *platyphyllos*, *Fraxinus excelsior*, *Acer campestre*, *Ulmus glabra*, *Acer platanoides*, although constant, participate only as accompanying species in the tree layer. The trunk diameter of trees ranges between 10 and 100 cm.

The shrub and regenerative layers have a cumulative coverage of up to 20%. *Fagus* spp., *Tilia platyphyllos* subsp. *platyphyllos*, *Acer platanoides* and *Tilia tomentosa* are more abundant in the regenerative layer. Of the shrubs, only *Euonymus europaea* is sub-constant, the other species being quite rare.

The herb layer coverages range between 5 and 30%, with *Carex pilosa*, *Anthriscus cerefolium* subsp. *trichosperma*, *Allium ursinum* subsp. *ucrainicum*, and *Galium odoratum* sometimes forming distinct facies. Other constant herbaceous species are: *Anemone ranunculoides*, *Asarum europaeum*, *Dentaria bulbifera*, *Carex digitata*, *Corydalis solida* subsp. *solida*, *Isopyrum thalictroides*, *Mercurialis perennis*, *Moehringia trinervia*, *Polygonatum latifolium*, *P. odoratum* subsp. *odoratum*, and *Viola reichenbachiana*.

Hemicryptophytes (H=37.5%), geophytes (G=25%), and phanerophytes (Ph=22.1%) (tree species=52.2%, shrubs=39.1%, lianas=8.7%) prevail in the structure of the life forms. The low share of hemitherophytes (Ht=9.6%) and therophytes (Th=5.8%) reflects a rather limited anthropogenic impact on this beech forest. The floristic elements are: Euro-Asiatic (29.6%), Central-European (13.3%), European (12.2%), Pontic-Balkanic (12.2%), Mediterranean and sub-Mediterranean (18.4%), Circumpolar (8.2%) and Cosmopolitan (6.1%). One can remark that out of the total of Eurasian and European *sensu stricto* species, there is also an important proportion

of Southern elements (e.g. Pontic-Balkanic, Mediterranean and sub-Mediterranean), which gives this forest a peculiar tone within the wider context of the beech forests of Romania.

Table 1: The phytosociological table of Ass. *Symphyto taurici–Fagetum taurici* ass. nova
* = holotype relevé

Relevé area (m^2)	400	400	400	400	400	400	400	400	400	400	400	400	
Aspect	NE	NE	-	-	NE	W	W	NE	W	NW	W	W	
Slope (degrees)	15	25	-	-	3	10	3	5	3	4	15	1-2	
Altitude (m a.s.l.)	98	103	102	133	135	136	142	140	145	151	152	156	
Tree cover/Consistency	0,8-0,9	0,9	0,8	0,75	0,7	0,75	0,7	0,8	0,7	0,7	0,7	0,7	
Tree height (m)	26-28	30-32	20-22	25	26-28	22-24	28-30	22	20-22	22-24	15-18	20-22	
Tree diameter (cm)	40-70	30-70	20-50	10-100	40-70	20-60	40-60	50	20-50	40-70	20-40	20-70	
Shrub layer coverage (%)	2	1	5	5	2	3	2	5	10	1	2	1	
Regenerative layer coverage (%)	5	2	3	2	5	2	3	5	10	2	3	2	
Herb layer coverage (%)	30	10	15	30	30	10	10	5	15	20	5	10	
Relevé no.	1*	2	3	4	5	6	7	8	9	10	11	12	K
Char. ass.													
Symphytum tauricum	+	+	1	+	+	-	-	-	-	+	-	-	III
Fagus taurica	5	5	5	4	2	4	3	3	3	2	3	2	V
Aro orientalis – Carpinenion													
Tilia tomentosa	+	-	-	+	3	+	1	1	1	1	+	3	V
Tilia tomentosa (juv.)	+	-	-	-	+	-	+	+		+	-	-	III
Arum orientale	-	+	+	-	+	-	-	-	+	+	-	-	III
Corydalis cava subsp. marschalliana	-	+	-	-	-	-	+	-	-	-	-	-	I
Scutellaria altissima	-	-	-	-	-	-	-	-	-	-	+	+	I
Lathyro hallersteinii-Carpinion													
Carpinus betulus	1	+	+	-	1	1	2	2	2	2	2	1	V
Glechoma hirsuta	-	-	+	+	-	+	-	+	+	+	+	-	III
Dactylis polygama	-	-	-	+	-	-	+	-	+	-	-	+	II
Cerasus avium	-	-	-	-	+	+	-	+	-	-	-	-	II
Scilla bifolia subsp. bifolia	-	-	-	-	-	+	-	-	+	+	-	-	II
Fagetalia sylvaticae													
Galium odoratum	+	+	+	+	-	+	+	1	+	+	-	+	V
Carex pilosa	-	1	1	2	+	+	+	+	1	2	1	1	V
Anemone ranunculoides	-	+	+	-	+	+	+	+	+	+	+	+	V
Allium ursinum subsp. ucrainicum	+	1	-	1	+	+	1	+	+	-	-	+	IV
Asarum europaeum	+	+	-	+	+	+	+	+	+	+	-	-	IV
Corydalis solida subsp. solida	-	+	+	-	+	+	+	-	+	+	+	+	IV
Fagus sylvatica	+	+	+	+	-	-	+	+	+	+	-	+	IV
Fagus spp. (juv.)	-	+	-	+	-	+	-	-	1	+	+	-	III
Isopyrum thalictroides	+	+	+	+	-	+	-	-	+	-	+	+	IV
Tilia platyphyllos subsp. platyphyllos	+	+	+	+	+	-	1	+	+	+	-	-	IV
Tilia platyphyllos subsp. platyphyllos (juv.)	+	+	-	-	-	-	+	+	1	+	-	-	III
Mercurialis perennis	-	+	+	+	+	+	-	+	+	+	-	+	IV
Pulmonaria officinalis	+	-	-	-	-	+	+	+	+	+	-	-	III
Sanicula europaea	+	-	-	-	-	+	+	+	+	-	-	-	III
Viola mirabilis	-	+	+	+	+	-	+	-	+	+	-	-	III

Geranium robertianum	+	-	-	-	+	+	+	+	-	-	-	-	III
Stachys sylvatica	+	-	-	-	+	+	-	-	+	+	-	-	III
Scrophularia nodosa	+	-	-	-	-	+	-	+	-	-	-		II
Milium effusum	-	-	-	+	+	+	-	+	-	-	-	+	III
Polygonatum multiflorum	-	+	+	-	+	+	+	+	-	-	-	+	III
Carex divulsa subsp. divulsa	-	-	-	-	-	-	-	+	-	+	-	+	II
Rumex sanguineus	-	-	-	-	-	+	-	+	-	+	-	-	II
Carex sylvatica	-	-	-	-	-	+	-	+	-	-	-	-	I
Alnion incanae et Alno-Fraxinetalia													
Aegopodium podagraria	+	-	-	-	-	+	-	+	-	-	-	+	II
Fraxinus excelsior	-	+	+	+	+	+	+	+	+	+	+	+	V
Circaea lutetiana	-	-	-	-	-	+	-	+	-	-	-	-	I
Geranium phaeum	-	-	-	-	-	-	-	+	-	+	-	-	I
Querco-Fagetea													
Acer campestre subsp. campestre	+	-	+	1	+	1	+	+	+	+	+	+	V
Dentaria bulbifera	+	+	+	+	+	+	+	+	+	+	+	+	V
Moehringia trinervia	+	+	+	+	-	+	+	+	+	+	+	+	V
Polygonatum latifolium	+	+	-	+	+	+	-	+	+	+	+	+	V
Viola reichenbachiana	+	-	+	+	+	+	+	+	+	+	-	+	V
Ulmus glabra	+	-	+	+	+	+	-	+	+	+	+	+	V
Ulmus glabra (juv.)	+	-	+	-	-	-	-	-	-	-	-	-	I
Acer platanoides	+	+	+	-	+	+	-	+	+	+	+	-	IV
Acer platanoides (juv.)	-	+	-	-	-	-	-	-	1	+	+	-	II
Carex digitata	+	+	+	-	-	-	+	+	+	+	+	+	IV
Hedera helix	-	+	+	+	-	+	+		+	+		+	IV
Anemone nemorosa subsp. nemorosa	+	+	+	-	+	-	+	-	+	-	-	-	III
Euonymus europaea	+	-	+	-	-	+	-	+	+	+	-	+	III
Geum urbanum	-	-	-	+	-	+	-	+	+	-	+	-	III
Poa nemoralis	-	1	+	-	-	-	+			+	+		III
Ranunculus ficaria subsp. bulbilifer	-	-	+	+	+	+	-	+	-	-	+	+	III
Corylus avellana	+	-	-	-	-	-	-	+	+	-	+	-	II
Melica uniflora	-	+	-	-	-	-	+	+	+	-	-	-	II
Dryopteris filix-mas	-	-	-	-	-	+	+	-	-	-	-	-	I
Lathyrus niger	-	-	-	-	-	-	-	-	-	+	-	+	I
Quercetea pubescentis													
Polygonatum odoratum subsp. odoratum	+	+	+	-	-	-	-	+	+	+	+	+	IV
Cornus mas	-	-	+	-	-	-	-	-	+	+	-	-	II
Bromus ramosus	-	-	+	-	-	-	+	+	+	-	-	-	II
Sorbus torminalis	-	-	-	-	+	-	-	-	+	+	+	-	II
Myrrhoides nodosa	-	-	-	+	+	-	-	-	-	-	-	-	I
Nectaroscordum siculum subsp. bulgaricum	-	-	-	-	-	-	-	-	-	-	+	+	I
Doronicum orientale	-	-	-	-	-	-	-	-	-	-	+	+	I
Rhamno-Prunetea													
Sambucus nigra	+	-	-	-	-	+	+	-	-	-	-	-	II
Euonymus verrucosa	-	-	-	-	-	+	-	-	+	+	+	+	II
Ligustrum vulgare	-	-	-	-	-	-	-	-	-	+	+	-	I
Crataegus monogyna subsp. monogyna	-	-	-	-	-	-	-	-	-	-	+	+	I

Galio-Urticetea													
Lamium maculatum	-	+	+	+	+	+	-	+	+	+	-	+	IV
Galium aparine	+	+	+	+	-	-	+	-	+	-	-	+	III
Anthriscus sylvestris	-	-	-	-	+	-	+	+	+	+		+	III
Anthriscus cerefolium subsp. trichosperma	-	+	+	1	2	-	-	-	-	-	+	+	III
Lapsana communis subsp. intermedia	-	+	+	-	-	+	+	-	+	+	-	-	III
Chaerophyllum temulum	+	-	-	-	+	+	-	-	-	-	-	-	II
Chelidonium majus	+	-	-	-	-	-	-	+	-	+	-	-	II
Alliaria petiolata	-	+	+	-	-	-	-	+	-	+	-	-	II
Chaerophyllum aureum	-	-	+	-	-	+	-	-	-	-	-	-	I
Urtica dioica subsp. dioica	-	-	-	-	-	-	-	+	-	+	-	-	I
Variae syntaxa													
Lamium purpureum	-	-	+	+	+	-	-	+	+	-	+	+	III
Veronica hederifolia subsp. hederifolia	-	-	+	+	+	+	-	+	-	+	+	-	III
Stellaria media	-	-	+	+	+	-	-	-	-	-	-	-	II
Ajuga reptans	-	-	-	-	+	+	+	-	-	+	-	-	II
Cystopteris fragilis	-	-	-	-	-	+	+	-	-	-	-	-	I

Species in a single relevé: Actaea spicata + (1), Angelica sylvestris subsp. sylvestris + (12), Arctium lappa + (10), Brachypodium sylvaticum + (12), Clematis vitalba + (1), Doronicum hungaricum + (11), Dryopteris carthusiana + (5), Equisetum telmateia + (12), Fragaria vesca + (12), Galanthus plicatus + (7), Galium spurium + (3), Hordelymus europaeus + (10), Lathraea squamaria + (10), Lathyrus venetus + (1), Lychnis coronaria + (11), Neottia nidus-avis + (9), Platanthera bifolia + (10), Quercus dalechampii + (11), Stachys officinalis + (8), Smyrnium perfoliatum + (7), Veronica serpyllifolia subsp. serpyllifolia + (8), Viburnum lantana + (9), Viburnum opulus + (10).
Date and place of relevés: 1-4: 01.05.2007; 5-6: 06.05.2007; 7-8: 25.05.2009; 9-12: 29.05.2010; Valea Fagilor forest – Luncaviţa (Tulcea county).

The average values of ecological indices for Ass. *Symphyto taurici–Fagetum taurici* ass. nova are as follows: $L_{4.8}T_{5.8}U_{5.0}R_{6.5}N_{6.0}$. According to the ecological indexes, this association includes sub-sciadophilous, micro-mezo-thermophilous, mesophilous, and acidic-neutrophilous plant species. However, a large number of species in the plant composition of the association have a wide ecological tolerance to soil reaction (41%) and temperature (44%).

The next dendrogram (Fig. 2) proves the distinctiveness of *Symphyto taurici–Fagetum taurici* relevés comparing with those from other beech communities from the eastern part of Romania. In the same cluster with this newly described association, but grouped in a distinct subcluster, are relevés belonging to other two beech communities, these being Ass. *Lathyro aurei–Fagetum* and Ass. *Galio schultesii–Fagetum*, both dominated by *Fagus sylvatica* and *F. taurica*. The relevés belonging to *Carpino–Fagetum* and *Symphyto cordati–Fagetum* associations are grouped in a separate cluster.

Discussion

Syntaxonomic framing and relationships to other beech forest types

The presence in Valea Fagilor (Dobrogea, Romania) forest of a beech species, namely *Fagus taurica*, as a dominant (AD=2-5), sporadically accompanied by *F. sylvatica* in the same tree layer, combined with a sub-constant presence of *Symphytum tauricum* in the herb layer (see also Dihoru [27]), made us ask ourselves whether this community could be another forest type, as opposed to beech stands from Moldova [2, 30] or in the bend of the sub-Carpathians (e.g. Siriu Mountains) [28].

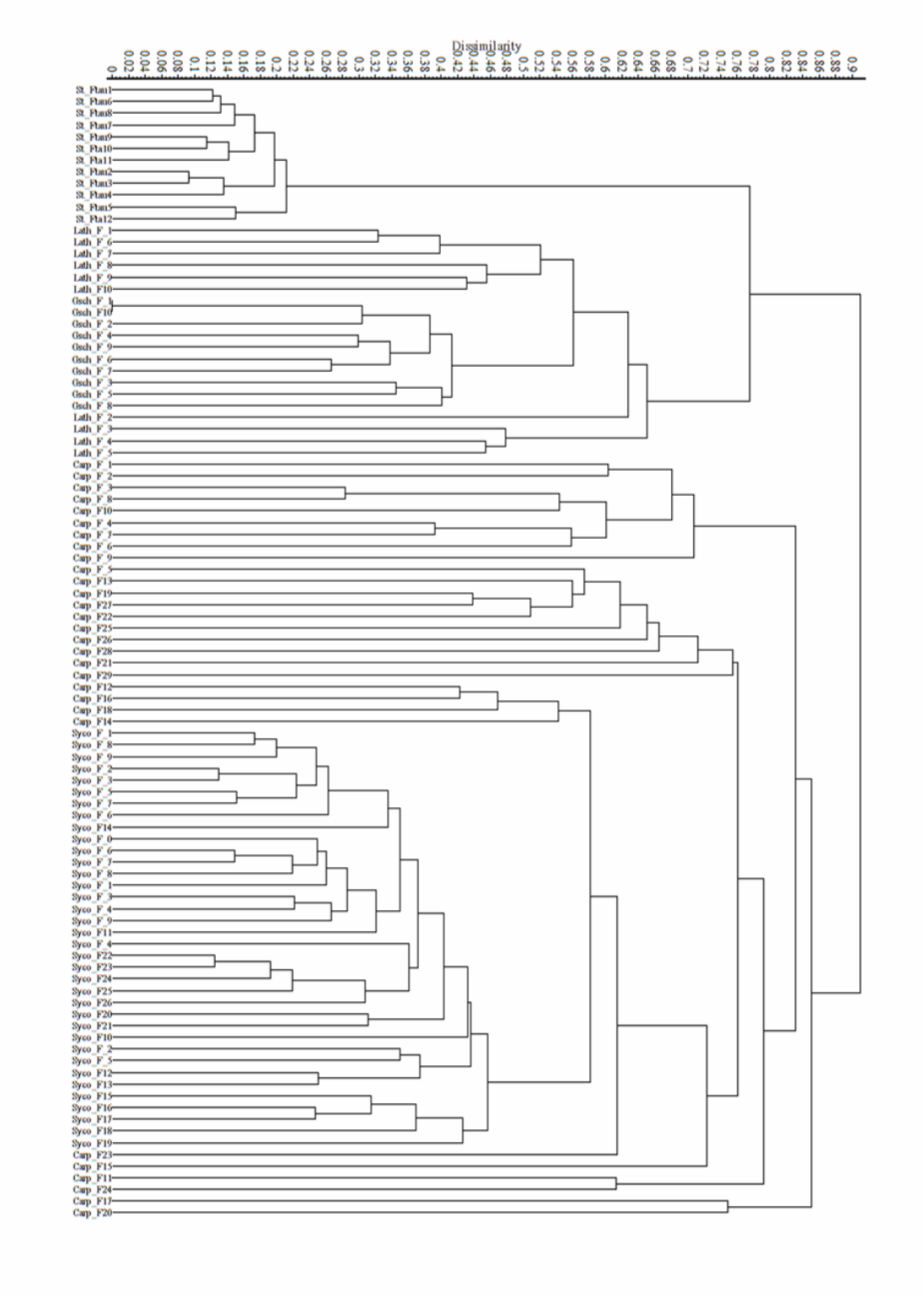

Fig. 2: Hierarchical clustering for different communities of *Fagus* forests (St_Ftau - *Symphyto taurici–Fagetum taurici*; Lath_F - *Lathyro aurei–Fagetum*; Gsch_F - *Galio schultesii–Fagetum*; Carp_F - *Carpino–Fagetum* and Syco_F - *Symphyto cordati–Fagetum*)

As already demonstrated in the introductory section, phytocoenoses of beech and hornbeam from Valea Fagilor forest were previously assigned to Ass. *Carpino-Fagetum* Paucă 1941, subass. *tilietosum tomentosae* Mititelu *et al*. 1977 [53]. The same approach was also taken in a recent paper [60].

However, the beech and hornbeam phytocoenoses from Dobrogea obviously differ from those described by Paucă from the Mountains of Codru-Moma [59]. First of all, in Valea Fagilor forest, the tree layer is dominated by *Fagus taurica*, which is completely absent from the beech and hornbeam phytocoenoses described by Paucă [59]. Secondly, a large number of species characteristic of the hornbeam and beech forests of Transylvania are not found in the beech and hornbeam stand from Dobrogea (i.e. *Aconitum vulparia* subsp. *vulparia*, *Aposeris foetida*, *Aremonia agrimonoides*, *Aristolochia lutea*, *Arum maculatum*, *Asplenium adianthum-nigrum*, *Asplenium ceterach* subsp. *officinarum*, *Deschampsia cespitosa* subsp. *cespitosa*, *Doronicum austriacum*, *D. columnae*, *Epipactis atrorubens*, *Erythronium dens-canis* subsp. *dens-canis*, *Gentiana asclepiadea*, *G. cruciata*, *Helleborus purpurascens*, *Hepatica nobilis*, *Ilex aquifolium*, *Lathyrus hallersteinii*, *Melampyrum nemorosum*, *Melittis mellissophyllum* subsp. *mellissophyllum*, *Prenanthes purpurea*, *Ranunculus auricomus*, *Ruscus aculeatus*, *R. hypoglossum*, *Sorbus aria*, *S. aucuparia*, *Tamus communis*, *Telekia speciosa*, etc.). In addition, the beech and hornbeam phytocoenoses from Valea Fagilor have a more thermophilic character, revealed by the presence of many elements of the class *Quercetea pubescentis* in the plant composition. Thus, the subordination of the Dobrogean phytocoenoses of beech trees to the association *Carpino-Fagetum* Paucă 1941 (published as *Carpineto-Fagetum* Paucă 1941, in the original paper [59]) cannot be justified.

Concerning the species *Tilia tomentosa* (silver lime), although constant in Valea Fagilor forest, we have noticed it only in two relevés having a higher coverage (30-35% coverage in the tree layer) (relevés nos 5 and 12, Table 1). Therefore, we cannot confirm that *Tilia tomentosa* could be a differential species over there, in order to define a subassociation, as has already been mentioned: *Carpino-Fagetum* Paucă 1941 *tilietosum tomentosae* Mititelu *et al*. 1977 [53].

Phytocoenoses dominated by beech and hornbeam in Dobrogea also differ from the hilly hornbeam-beech forests from Moldova (i.e. Ass. *Galio schultesii-Fagetum* (Burduja *et al*. 1973) Chifu et Ştefan 1994 and Ass. *Lathyro venetus-Fagetum* (Dobrescu et Kovács 1973) Chifu 1995) [15, 16, 18, 19, 20, 30]. The characteristic species of the stand dominated by beech trees in Valea Fagilor, *Symphytum tauricum*, has a Tauric-Scythian–North Anatolian–Pontic-Continental area, partially overlapping with that of *Fagus taurica* (an East–SE European element) [21], according to Săvulescu [69]. In the Romanian flora, *Symphytum tauricum* occurs only in Dobrogea. Other characteristic plants of the Valea Fagilor forest, such as *Doronicum hungaricum*, *D. orientale*, *Galanthus plicatus*, *Myrrhoides nodosa*, *Smyrnium perfoliatum*, etc., having a South-East European (Pontic-Balkan-Mediterannean) distribution, were never found in other forests dominated by beech in Romania [8, 15, 16, 18, 19, 20, 22, 28, 30, 59, 74]. In addition, unlike the hilly hornbeam-beech forests from Moldova, phytocoenoses dominated by Crimean beech from Dobrogea are devoid of some Circumpolar (*Hepatica nobilis*), Endemic (*Hepatica transsilvanica*, *Melampyrum bihariense*), European (*Cephalanthera damasonium*, *C. longifolia*, *C. rubra*, *Rubus hirtus* subsp. *hirtus*), Central European (*Acer pseudoplatanus*, *Aposeris foetida*, *Epipactis helleborine* subsp. *varians*, *Galium schultesii*, *Pulmonaria mollis*), or even Eurasian elements (*Campanula trachelium*, *Epilobium montanum*, *Epipactis helleborine* subsp. *helleborine*, *Ranunculus auricomus*).

Compared with other Carpathian beech forests (Ass. *Symphyto cordati–Fagetum* Vida 1963), the Dobrogean beech communities are clearly distinguished, both through the dominant species in tree layer, and through the very different composition of the herbaceous layer [8, 22, 28, 74].

Therefore, based on these data, we appreciate that there are enough reasons to differentiate the beech stand from Dobrogea in the wider context of forests dominated by beech from the eastern part of Romania. Consequently, we believe that the description of a new syntaxon in this paper is fully justified.

The classification of this association within the sub-alliance *Aro orientalis–Carpinenion* (Dobrescu et Kovács 1973) Taüber 1992, alliance *Lathyro hallersteinii–Carpinion* Boşcaiu *et al*. 1982, and order *Fagetalia sylvaticae* Pawlowski in Pawlowski et al. 1928, is justified through the existence in phytocoenoses dominated by the beech trees of a large number of characteristic species for these syntaxa (*c.* a third of the total number of species).

Synecological aspects

The general climatic conditions seem not to be ideal for a beech stand in Northern Dobrogea (annual average rainfall of 415–500 mm and the yearly mean temperatures of 10.9 °C [1, 55]). For comparison, in the area of beech and hornbeam forests from Moldova, the average annual temperature is of 7.5–9.5 °C, and annual average rainfall is of 450–550 mm; in the area of mountain beech forests the average annual temperature is of 4–7 °C and annual average rainfall is of 650–850 mm [17, in 50].

However, it seems that some local topographic and hydrological factors (the general Northern aspects of slopes, the existence of several springs which are collected by the Valea Fagilor rivulet, flowing in a long and narrow valley) contribute to favourable climatic conditions for the beech trees. It appears that a certain reduction in rainfall can be compensated by an increased atmospheric humidity, which allows beech to descend in valleys in the hilly regions. The existence and continuity of the beech stand in Dobrogea is due to the fact that it is established in a long, narrow valley, sheltered from air currents and summer heat. Valea Fagilor is approximately 1 Km long, being more or less closed in its southern part. The dominant winds are from the North and North-East [1].

In the plant composition of these phytocoenoses are some (mezo-) hygrophilous species (e. g. *Rumex sanguineus*, *Stachys sylvatica*, *Scrophularia nodosa*, *Equisetum telmateia*, *Angelica sylvestris* subsp. *sylvestris*), indicating an increased soil moisture, mainly along the valley. This has a great importance in maintaining a natural regeneration of the beech trees in this forest [27].

The remarkable vigour of some individuals of beech (up to 32 m tall, trunk diameters up to 100 cm), the high consistency of the tree layer (0.7–0.9), in which beech trees have usually a dominant role, the large number of beech seedlings, all these proving that this species has good growth conditions in Valea Fagilor forest. This finding is also supported by the existence in the herb layer under the trees of many plant species common to the beech forests in mountain and hilly areas (characteristic of Ord. *Fagetalia sylvaticae* and Cl. *Querco-Fagetea*) (Table 1; see also Dihoru [27]).

The origin hypothesis of beech trees in Dobrogea

Based on the analysis of a spore and pollen chart from the Lozna peat bog (Botoşani county, NE Romania), Boşcaiu *et al*. [9] refuted the hypothesis of a possible glacial refugium of beech in that region (North Moldavia, Romania). The beech curve of that chart, although it is reconstituted in an extra-Carpathian area, presents a complete similarity with that of the Carpathian beech forests.

On the other hand, in a spore and pollen chart from the peat bog of Mangalia-Herghelie (Southern Dobrogea), Diaconeasa (1977) [25] takes into consideration that beech (*Fagus* spp.) arrived much earlier in Dobrogea than in other southern regions of Romania, coming from the southern Balkan Peninsula, during the transition climate from Glacial to Postglacial [25]. Later, during the Sub-Atlantic age, beech spread throughout the country, as the climate was cold and wet. Other palynological analyses of mud in some lakes of the Romanian Plain has revealed the presence of beech pollen at high percentages, this having been carried by North-West winds from the farther forests of the Vrancea Mountains [26].

Comparing different charts in different parts of the country led to the idea of a unique history of beech, both in the inside and outside areas of the Carpathians. Thus, there is the

assumption of a large area of beech forests in the Atlantic era, in the area between the Carpathians and the Eastern boundary of current distribution of beech (on the Dniester river) towards the Northern Dobrogea [10, 27].

Borza [6] stated that the presence of beech stands during the cold and dry climates of glacial times in the Bessarabian Plateau seems to be quite problematic. He, also, predicted the separation of beech forests, out of the Carpathians, from Eastern Romania in a regional alliance, namely All. *Fagion moldavo-podolicum*. The beech forests, out of the Carpathians, could have come from the South of the Danube river, at the foot of the Carpathians, and should not be overlooked even "…the role of the beech forests of Northern Dobrogea and Crimea, in those movements of floras…" [10]. Even Borza said, in 1931, that *Fagus orientalis* is a Tertiary relict species that had found refuge in the Northern Dobrogea (*Fagus sylvatica* originated in the Quaternary era) [5]. However, it is assumed that there would be more grounds for the hypothesis of a relationship between populations of the Moldavian-Podolian Plateaux and Dobrogean beech stands than those of the Crimea.

Georgescu [45] states that the beech stand from Dobrogea lasted there from the Tertiary era, being a relict of a great importance, suggesting a connection that then existed between Dobrogea and the Carpathians. The podzolic soils would prove the existence of a period with more rain in the past, which allowed the installation and continuity of beech forests over the period. This is also sustained by the fact that there still exists a common fund of species in the herbaceous layer, as has already been shown by Dihoru [27]. The Valea Fagilor forest has many herbaceous species in common with the beech forests in the bend of the sub-Carpathians or the Central Moldavian Plateau, as well as in some beech remnants of the Muntenia Plain.

One should note that *Fagus taurica* is at its North-western distributional limit, here in Romania (its main distribution areas are in the Balkans and Crimea) [3, 52].

Rare plants in "Valea Fagilor" Nature Reserve

The floristic list includes some plants rare in Romania, such as: *Doronicum orientale* – CR [29]/R [57], *Galanthus plicatus* VU [29]/R [57], *Myrrhoides nodosa* R [57], *Nectaroscordum siculum* subsp. *bulgaricum* R [57], *Smyrnium perfoliatum* R [57], *Symphytum tauricum* VU [29]/R [57], in [27, 53]; others are rare in Dobrogea, such as: *Cystopteris fragilis* [27], *Doronicum hungaricum* [53], *Dryopteris filix-mas* [27], *Equisetum telmateia* [pers. obs.], *Lathyrus aureus* [pers. obs.], *Sorbus torminalis* [27], etc.

Other species are cited as present inside the limits of the broader nature reserve (i.e., not in the beech stand itself), such as: *Asplenium scolopendrium* (in Dobrogea, at this location only) [27, 53], *Dentaria glandulosa* [53], *Carpinus orientalis* [53], *Dryopteris carthusiana* [Ciocârlan, pers. comm., 2010], *Galanthus elwesii* R [57], in [53], *Lathyrus cicera* [53], *Loranthus europaeaus* [53], *Potentilla inclinata* [53].

The tourism guide for the Măcin Mountains states that there are beech trees here 38 m high and *c*. 1 m in diameter, centuries old [1].

Dihoru said there were *c*. 200–250 mature beech trees in this stand (in 1962!) [27]. On the other hand, Mititelu (in 1997), said that over 1,050 mature beech trees and *c*. 25,000 beech saplings (!) were counted [53]. Our observations confirm the existence of over 200 mature beech trees, of *c*. 32 m high, some trees having a diameter of around 100 cm. We also saw that natural regeneration of beech is present via many seedlings, but that there are few juvenile trees.

Habitat classifications: the Dobrogea beech stand falls under the following various categories:

– Palaearctic Habitats (1999): !41.1F Beech forests [24].
– Interpretation Manual of European Union Habitats – EUR27: 91X0* [Dobrogean beech forests] [42, 44].
– Corine Habitats: 41.1F Beech forests from Dobrogea [54].

– Forestry typology: this forest fall as a distinct subtype of the type 70: Hilly beech forests with mull flora [58].

– Habitats of Romania: **–** [36–37].

Threats: uncontrolled logging around the beech stand, which exploits many cubic metres of wood, especially lime and hornbeam, for domestic heating, as well as for pulp and paper production.

Finally, it should be mentioned that the presence of some species reported in the Valea Fagilor forest is questionable, namely *Salix elaeagnos* [53], and *Quercus petraea* [27, 53].

Conclusions

Investigations on the vegetation of the Măcin Mountains, Northern Dobrogea, has led to the description of a unique beech forest association in Romania.

This new association, based on field surveys, as well as on other previously published studies on the beech communities in Romania, clearly distinguishes the beech stand from Dobrogea from the other beech forest types in Eastern Romania.

This beech forest is the only place in Dobrogea that holds certain Balkan and Oriental species, which determined us to describe a new association, Ass. *Symphyto taurici–Fagetum taurici* ass. nova, based on the presence of *Symphytum tauricum* in the herbaceous layer, and *Fagus taurica* as a dominant species in the tree layer.

"Valea Fagilor" Nature Reserve hosts some plants rare in the Romanian flora, such as: *Doronicum orientale*, *Galanthus elwesii*, *G. plicatus*, *Myrrhoides nodosa*, *Nectaroscordum siculum* subsp. *bulgaricum*, *Smyrnium perfoliatum* and *Symphytum tauricum*.

The existence of the beech trees in the Valea Fagilor forest (Luncaviţa, Tulcea county) is due to its location in a narrow, wet valley, sheltered from air currents and hot summers.

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VEGETAŢIA REZERVAŢIEI NATURALE "VALEA FAGILOR" - LUNCAVIŢA (JUDEŢUL TULCEA, ROMÂNIA)

(Rezumat)

Studiul nostru completează descrierea unui anumit tip de habitat natural (în sensul Directivei Habitate 92/43/EEC), izolat, întâlnit doar într-o rezervaţie naturală din Dobrogea (România), şi anume, 91X0 * *Păduri dobrogene de fag*, habitat descris în Manualul de interpretare a habitatelor naturale din Uniunea Europeană - EUR-27.

Importanţa acestei păduri cu regim de rezervaţie naturală constă în existenţa aici, în singurul refugiu din Dobrogea, a unei insule de fag, situată departe de făgetele aflate fie în Subcarpaţii de Curbură, fie în Podişul Central Moldovenesc, regiunile cele mai apropiate cu astfel de tipuri de păduri. Totodată, existenţa acestui făget a determinat descrierea unui tip particular de habitat „Natura 2000" şi anume: 91X0* *Păduri dobrogene de fag*, habitat prioritar pentru conservare în Uniunea Europeană, în conformitate cu Anexa 1 a Directivei Habitate 92/43/EEC.

Flora acestei păduri cuprinde unele specii rare în flora României (inclusiv în Dobrogea), precum: *Asplenium scolopendrium*, *Carpinus orientalis*, *Doronicum hungaricum*, *D. orientale*, *Galanthus elwesii*, *G. plicatus*, *Lathyrus aureus*, *Myrrhoides nodosa*, *Nectaroscordum siculum* subsp. *bulgaricum*, *Smyrnium perfoliatum*, *Symphytum tauricum* etc.

În lucrare sunt discutate aspectele privind structura floristică şi cenotaxonomică a acestui făget, descriindu-se o nouă asociaţie vegetală, în baza investigaţiilor de teren efectuate între anii 2007 şi 2010, precum şi a bibliografiei de specialitate consultate.

Pe baza speciilor caracteristice, precum şi a prezenţei speciei *Fagus taurica*, dominantă în stratul arborescent, s-a descris şi tipizat o nouă asociaţie, şi anume: As. *Symphyto taurici–Fagetum taurici* ass. nova.

În studiul nostru se mai arată că fitocenozele dobrogene cu fag nu conţin specii caracteristice făgetelor din Carpaţi sau din Podişul Central Moldovenesc, existând însă unele specii balcanice şi orientale, care imprimă acestui arboret un caracter aparte.

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