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Syntaxonomy of Hungarian oak (*Quercus frainetto* Ten.) forests in Eastern Romania (Moldavia)

Abstract

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The distribution of the Hungarian oak (*Quercus frainetto*) in Romania is analyzed, along with the phytocoenological framing of the plant communities including this species in the Romanian literature. There are discussed the necesity of a newly proposed infracoenotaxa. In the Romanian flora, the Hungarian oak has a limited geographical distribution, namely in the south-west and north-west of Transylvania, Crișana, Banat, Oltenia, Muntenia, and Dobrogea, i. e. mostly in the western and southern parts of the country. Only relatively recent (since 1961), this species has been identified in the southern parts of Moldavia, namely in the hills of Tutova and Covurlui, in a very few forests. The forests of Hungarian oak are settled in the forest-steppe zone and in some cases reach even the lower part of the beech belt of vegetation, in hilly zone, between 230-400 m a.s.l., on plateaux or on sunny slopes, with south, east or west aspects, inclined at 5°-30°, in the oak (*Quercus robur*) area and in the lower part of the beech (*Fagus sylvatica*) floor. The phytosociological researches carried out on stands with *Quercus frainetto* in the historical province of Moldavia, led us to propose a new plant community, at the level of subassociation, based mainly on relevés made in the most typical stands with Hungarian oak in Eastern Romania. The new proposed subassociation, quercetosum frainetti subass. nov., is framed within ass. *Quercetum frainetto-cerris* Rudski 1949. It is pointed out that of the two co-edifying species of the ass. *Quercetum frainetto-cerris*, only *Quercus frainetto* is present as a wild species in Moldavia, while *Quercus cerris* is totally absent. The following plant species are given as characteristic (diagnostic) ones for Moldavian Hungarian oak stands: *Quercus dalechampii, Symphytum ottomanum, Ornithogalum orthophylllum* subsp. *kochii, Vinca herbacea, Sorbus domestica,* as well as *Carex muricata* subsp. *muricata*. The structure of the live's forms of this new proposed plant community is dominated by hemicriptophytes, phanerophytes, and terophytes, while in the phytogeographic structure the Eurasian species are dominant, followed by the European ones, with an important participation of the meridional species *sensu lato*.

Key words: Hungarian oak, plant communities/plant associations, new proposed subassociation, forest-steppe & nemoral vegetation, Eastern Romania.

Introduction

The Hungarian oak (*Quercus frainetto* Ten., *Q. conferta* Kit., *Q. pannonica* Hort., *Q. hungarica* Hubeny, *Q. esculus* Griseb., *Q. strigosa* Wierzb., *Q. spectabilis* Kit.) is a balcan-italian-central european-northwest Turkey area, being distributed in: Albania (Ruci & al. 2001), Bulgaria (Assyov & al. 2006; Lyubenova & al. 2014), Greece (except Crete and Karpathos island groups) and East Aegean Islands (Dimopoulos & Georgiadis 1995; Strid & Tan 1997), Hungary (Soó 1963; Gergely & al. 2009), Slovakia (Roleček 2005), South & Central Italy (Blasi & al. 2002), ex-Jugoslavia (Krstić & al. 2015), Macedonia (Medwecka-Kornaś & al. 1986), Croatia (Nikolić 2015; Baričević & al. 2015), Bosnia and Herzegovina, Serbia (Baričević & al. 2015), N-W of Turkey (without East Aegean Islands) (Kavgaci & al. 2011; Babac & al. 2017), and Romania (Săvulescu 1952; Jalas & Suominen 1976; Davis 1982; Schwarz 1993; Bohn & al. 2000; Caudullo & al. 2017; Euro+Med PlantBase).

In Romania's flora, the Hungarian oak has a limited geographical distribution, in SW and NW of Transylvania, Crişana, Banat, Oltenia, Muntenia, and Dobrogea historical provinces (Săvulescu 1952; Doniţă & Roman 1976; Pop & Cristea 1999-2000), as well as in S of Moldavia, namely in Tutova and Covurlui Hills (Lupe 1961; Lupe & Dobrin 1961; Bârcă 1969, 1971, 1973; Mititelu 1975; Dobrescu 1980; Mititelu & al. 1993; Mititelu & Huţanu 1996). Although it is also quoted from the forestry-park Gârboavele, Galaţi county (Lupe 1961), it is possible that is most likely cultivated there!

From the distribution data of Hungarian oak in Romania, it is found that it is frequent only locally (in some cases it may become a subdominant species in the composition of certain types of tree stands), in the plain and hilly areas, from the forest-steppe zone (Lupe & Dobrin 1961) to the sessile oak belt of vegetation (*Q. petraea* s. str.) (e.g. forest "la Lac" - in N-W of Căuia de Jos village, Bacău county (Bârcă 1969)) and in the hill mixed forets with mull flora, from the nemorose zone. Here and there, it goes right up to the beech belt of vegetation (e.g. forest "Temnicul de Sus", W of Bodeasa village, Bacău county (Bârcă 1969)).

In Romania, the Hungarian oak builds forests, especially mixed with *Quercus cerris*, sometimes with *Q. pubescens* or *Q. pedunculiflora*, rarely building pure stands, for example, some forests in Olt county (Beldie 1977).

According to some sources, the spreading area of *Q. frainetto* in Romania's vegetation covers ca 130,000 ha (Şofletea & Curtu 2007).

Ecology of Hungarian oak in Romania

Quercus frainetto is a xero-mesophilous (Ciocârlan 2000) or meso-xerophilous–xerophilous, subtermophilous-termophilous, euritrofic species (Beldie 1977), usually growing on sunny slopes or on plateaux, where the groundwater level is profound (Sanda & al. 2004), being able to grow even on pretty heavy clay soils (Curtu & al. 2011).

The geological substratum on which the Hungarian oak stands are installed is represented by: loess, loessoid remanent deposits, alternations of Romanian sands with sandstones, calcareous marls, and so on. (Lupe & Dobrin 1961). In particular cases, the installation of these stands are due to the layer of Romanian gravels over which fine alluviums have been deposited, forming clay soils in the B horizon, with a strong leaching of the Ca carbonates,

which thus reach 1.2-1.5 m depths, as is the case with the pure stands of *Q. frainetto* at north of Slatina, between Olt and Cotmeana rivers (Marcu 1962).

The pedological substrate on which the Hungarian oak stands are installed in Romania is represented by the following soil types: forest ashes soils, brown-reddish of forest, brown-yellowish of forest, brown-gray or brown of forest, often slightly podzolite, *p*H 5-6, rarely below 5, with 1.5-6% humus in the A horizon and the saturation in bases in the same horizon ranging from 66% to 80% (Sârbu 1979).

The Hungarian oak also develops on chernozems, carbonate chernozems and chocolate chernozems, incipient to strongly levigated, in south of Romania (Sanda & al. 2004). Generally, they are heavy, deep soils, with fine texture, often surface-water gleyzated (Dumitriu-Tătăranu 1960; Beldie 1977), loam-sandy-clayey, usually compact or very compact in the B horizon, often with a heavy drainage (Beldie 1977). These soils have an alternating or a strongly alternating hydrologic regime, which may be quite damp in springs due to the melting of snow and water stagnation, or from the precipitation of the season (Beldie 1977). The soils are cold and therefore, the early spring flora lacks to a greater extent than in other types of Quercus spp. stands (Sanda & Popescu 1971; Popescu & al 1984; Bârcă 1984). Thus, some mesophilous or meso-hygrophilous species may appear in these stands, such as: *Circaea lutetiana*, *Ranunculus constantinopolitanus, Solanum dulcamara*, *Lysimachia punctata*, *Cardamine flexuosa*, *Cystopteris fragilis*, *Gladiolus imbricatus*, *Platanthera chlorantha*, *Lysimachia vulgaris*, *Rubus caesius*, *Valeriana officinalis* subsp. *officinalis*, etc. (Păun 1964; Boşcaiu & al. 1971; Popescu & Sanda 1974; Nanii 1975; Bârcă 1984; Popescu 1988; Popescu & al. 2005; Matacă 2005). Later on, as early as the summer the soils dry out more or less in the superficial layers, so most of the species of shrub or herbaceous layers are xerophilous or xero-mesophilous ones.

Quercus frainetto is distributed in southern Moldavia under ± similar biotope conditions, building up mixed forests as an edificator and dominant species, being accompanied by *Q. dalechampii* in the tree layer, a meso-xerophilous species, with slightly higher demands on humidity, which during the summer time is often deficient in this region (Beldie 1977; Sârbu 1978).

The climate in the distribution area of the Hungarian oak in Romania

Within the distribution area of *Q. frainetto* in Romania, the yearly average temperatures are between 9.5 and 11.7 °C, and the multiannual average of precipitation is between 491.5 and 715 mm (Roman 1974; Pop & Cristea 2002).

In the south of the country (Muntenia, Oltenia, Banat), this species grows at an yearly average temperature of +10.6 °C, the average for January of +2.7 °C; the average for July of + 22.1 °C; the absolute minimum temperature of -31 °C; absolute maximum temperature of +40.5 °C; late frosts do not cause leaf damages, as the lignaceous species end up late due to wet and cold clay soils in spring; the annual average rainfall are of 515-600 mm; the average yearly atmospheric humidity is of more than 75%, but in the summer time is of cca 65% (Marcu 1962).

In Moldova, this species is growing at a medium temperature of +9.5 °C in the Tutova Hills and 9.9 °C in the Covurlui Hills (the absolute maximum temperatures: –35.5 °C in the Tutova Hills and –27.7 °C in the Covurlui Hills; +39.7 °C in the Tutova Hills and +37.7 °C

in the Covurlui Hills) and the average annual rainfall of 491.5 mm in Tutova Hills and 529.4 mm in Covurlui Hills (Bârcă 1973; Sârbu 1978).

Forest types of Quercus frainetto *in Romania*

The Hungarian oak (*Q. frainetto*) and the Turkish oak (*Q. cerris*) tree stands are installed in various forestry types in Romania, as follows (the nomenclature is compliant with Paşcovschi & Leandru 1958):

- on neogene sedimentary formations, rarely on gneissy rocks, strongly drained, which have formed soils in various stages of podzolisation, in the south of Mehedinţi Plateau (Roman 1974)
- on degraded (by hydrogensys) podzol soils, clays, with a lot of gravels, *p*H 4.85-5.15, made on crystalline rocks (gneiss) and marls, covered by mull, in Zarand Mountains (Ghişa & Kovács 1963)
- on clay substrate or on crystalline shales, with very strong podzolited soils, very compact, heavily permeable, continuously subject to seasonal variations of humidity, very humid in springs and strongly dried in summers, on plateaux and slopes with various inclinations and aspects, at 150-360 (-550) m a.s.l. (above sea level), in warm and arid microclimates, also in the Zarand Mountains (Pop 1978)
- on neutral to weak acid soils, between 600 and 700 mm isohiets, these tree stands being mesophilic and represented by disparate vestiges, at the foot of the Ţarcu, Godeanu and Cerna Mountains (Boşcaiu 1971)
- on sunny or isolated on ridges, on brown, acidic, low skeletal, medium deep, low humics, oligobasic and oligotrophic soils, with dry-humid regime in the summers, in the middle basin of Jiu river (Sanda & Popescu 1981)
- on sunny slopes in the hill and piedmont belts of vegetation, on clay-illuvial podzolic soils, poorly surface-water gleyzated, with a medium humus content, on the Crişul Alb valley (Ardelean 1999)
- on flat lands, plateaus or southern slopes, on brown-forest soils, often strongly surface-water gleyzated, with deep phreatic water, often more than 50 m (Păun 1964), or on brown-reddish forest soils, in the state of forestry complementary pedoclimax, under whose action it was formed, in Oltenia (Nanii 1975)
- on brown-red soils of forest, in different stages of leaching, compacted, with a higher percentage of carbonates, both species being calcifilous, in Oltenia and Muntenia (Păun 1964; Sanda & Popescu 1971)
- on high plains (plateaux), on compact, brown of forest soils, ± podzolited, with a high percentage of carbonates; by the erosion of the slopes has reached to sands and gravels, thus appearing light texture soils, still enough compacted; the ground water is at high depth (over 100 m), on plateaux lacking the waters, which makes water supply be exclusively from precipitations; the soils are kept cold and that is why the early spring flora lacks to a greater extent than in other types of *Quercus* spp., în Muntenia Plain (Sanda & Popescu 1971; Popescu & al. 1984)
- on flat land, sometimes interrupted by deep and narrow valleys (of Vedea, Plapcea, Cotmeana rivers etc.), on a substrate of Romanian gravels, whose depth increases from north to south; the dominant soils on the plateaux are of the brown-forest type, ± pod-

zolited, clay to clay-loamy texture, with a very compact B-horizon, water and air impermeable, with a high level of carbonates leached at high deths, an excessive drainage of the soils among the subsoil gravels, as well as in deep valleys; the soils are strongly compacted and poor in Ca, with alternating drying and strong soaking, the Hungarian oak being almost the only species that can withstand (in Seaca-Optăşani forest this stand is situated on plateaux, installed on brown-forest soils, medium podzolited, or on poorly surface-water gleyzated soils, located on clayed loams), in north of Muntenia (Marcu 1962)

- on loess, rich in humus soils, with degraded chernozem features; the forests consists mainly by *Q. frainetto*, including species of forest-steppe, in the forest-steppe island between Costeşti-Corbu-Miroşi-Cornăţel, in Muntenia (Paşcovschi & Doniţă 1967)
- in warm, sheltered places, at 90-250 m a.s.l., on soft to strong ridges, in S, SE, SW or NE aspects, usually at the boundary between mesophylous and xerotermic belts of vegetation, on loess or limestones, on brown-reddish soils, ± podzolited, deep, very compacted in B horizon, rather poor in humus; on the plains at the foot of the cuesta and on the lowlands of northern Dobrogean Tableland (between 100 and 120 m a.s.l.) appear on substrates that always have a thick loess, with soils of the leached chernozem types, deep, rich in humus, with a high trophicity (Dămăceanu & al. 1964; Dihoru & Doniţă 1970)
- on light slopes, on brown-forest soils, slightly podzolited, formed on loess, in a moderate climate, with very warm summers and not too cold winters, in SW Dobrogea (Arcuş 1999)
- on a relief generally hilly, very fragmented, with high and low hills, with eroded degraded slopes, on plateaux or on sunny slopes, with E or W aspects, on brown-forest soils, forest-ash soils, or degraded clay chernozems, in Tutova Hills (Bârcă 1973)
- in the forest-steppe area, in the area of interference with the *Q. pubescens* forests, at altitudes between 200 and 300 m a.s.l., on E, S or Waspects, or on plateaux, on gray and brown soils of forests, formed on reshuffled loessoid landfills, slightly podzolited, with *p*H 5-6, rarely below 5, with 1.5-6% humus in A horizon, the degree of saturation in bases in the same horizon ranging from 66% to 80%, in Covurlui Hills (Sârbu 1978).

Phytosociological framing of the Hungarian oak stands in Romania

In the neighboring countries of Romania, the Hungarian oak stands were framed within the next coenotaxa: ass. *Quercetum frainetto-cerris* Rudski 1949 (Syntax. syn. Ass. *Quercetum frainetto-cerridis* (Rudski 1949) Trinajstić & al. 1996) (Trinajstić & al. 1996).

Various infracenotaxa have been described within this association, such as: *macedonicum* Oberd. 1948 em. Horvat 1959 and *carpinetosum orientalis* in Macedonia (Medwecka-Kornaš & al. 1986), *thracicum* (Syntax. syn. *bulgaricum*), *quercetosum pedunculiflorae* and *quercetosum virgilianae* in Bulgaria (Medwecka-Kornaś & al. 1986), *moesiacum* (Syntax. syn. *serbicum*) and *carpinetosum orientalis* in Serbia (Rudski 1949), *fraxinetosum orni* in northern Greece, Macedonia and southern Bulgaria (Medwecka-Kornaś & al. 1986), *typicum* and *carpinetosum betuli* (Rudski 1949), *ruscetosum* (Jovanović & Dunjić 1951), *nudum* and *hieracietosum* (Jovanović 1967) or *carpinetosum betuli* in Croatia (Baričević & al. 2015), *comandretosum*, *fagetosum*, *juglandetosum*,

paeonietosum, *physospermetosum*, *pubescentosum*, *petraeae*, *roboris*, *virgilianae* and *scardicum* in Kosovo (Medwecka-Kornaš & al. 1986), etc.

The Hungarian oak stands in Romania have been studied relatively less from phytocenologically point of view, but have been relatively well described from the point of view of forest typology (Paşcovschi & Leandru 1958). Most often, the Hungarian oak is a mixed species, being codominant with the Turkey oak (*Q. cerris*) in the south and west of the country.

From phytoecoenological point of view, the Hungarian oak rarely builds stand-alone stands in the vegetation of Romania, ± pure, especially in Muntenia, in the forest-steppe between Ialomiţa and Danube rivers, under the name of ass. *Quercetum confertae* (Paşcovschi & al. 1956), between Olt and Teleorman rivers, on the left side of the Olt river, at north-east of Slatina, in Seaca-Optăşani forest, the forest from south of Dobroteasa, Oporelu, Sineşti, Stolnici, etc. (Marcu 1962), in the area of north of Scorniceşti, in the forests of Poboru and other forests in the area (Popescu & al. 2005), or in codomination with the Turkish oak, in the forests Pustnicu and Brăneşti nearby of Bucharest (Sanda & Popescu 1971; Popescu & Sanda 1974; Popescu & al. 1984; Sanda & al. 1998).

The Hungarian oak stands also occur, here and there, in Oltenia, in the former Balş district, grouped under the name of *Querceto farnetto* (Păun 1964, Popescu 1988) or in the Zarand Mountains, framed in ass. *Quercetum frainetti* (Ghişa & Kovács 1963), later assigned to ass. *Quercetum frainetto-cerris* Rudski 1949, distributed between the Hungarian oak stands and sessile oak-Turkish oak stands or between sessile oak stands (Pop 1978).

Coenotaxa/infracoenotaxa of Hungarian oak communities within Romania's vegetation

In the romanian literature there are described some coenotaxa (as associations, subassociations, facieses, regional variants) with Hungarian oak, reflecting local flora or climatic peculiarities, with the predominance of certain species (it should be noted that most of the infracenotaxa are not yet valid described in the literature):

- ass. *Quercetum frainetto-cerris* Rudski 1949 (Syntax. syn. *Quercetum cerris* Georgescu 1941) - distributed on western foothills (Pop 1967, Coldea 1970, 1971), Plopişului Mountains (Coldea 1972), Tăşnadului hills (Karácsonyi 2011), the Gorge of Crişul Alb river (Ardelean 1999), Zarandului Mountains (Ghişa & al. 1971), Lugojului foothills (Vicol 1974), Dognecei Mountains (Hoborka 1980), between Mehadia and Cruşovăţ (Boşcaiu 1971), the hills of Silagiului and Buziaşului plain (Lovász 1995), Almăjului Depression (Peia 1978), Aninei Mountains (Schrött 1968) and Locvei Mountains (Coste 1975), the basin of Motru river (Costache 2005), the basin of Cerna of Olteţ river (Răduţoiu 2006), Getic subCarpathians (Păun 1964), the south of Mehedinţi tableland (Roman 1974), Pleniţa (Nanii 1975), Balş (Păun 1964), Muntenia Plain (Pop & Cristea 2002), etc. It is an association that brings together the nemoral forests in the subzone of the subtermophilous oak species of *Q. frainetto* and *Q. cerris* in the Balkan Peninsula, situated north of the Danube river, between 400 and 500 m a.s.l., on plateaux and slopes with various aspects and inclinations, in warm and arid microclimates, on substrates represented by loess, clays or crystalline shales, on deep soils, brown of forests, chernozems and brown-reddish, strongly podzolited, with a high percentage of carbonates, fine texture, compacted, heavily permeable, subject to seasonal variations of humidity;

the phytocoenoses dominated by one of the two above mentioned species are found on the periphery of the association's area, so sometimes they present transitions to the communities of the Al. *Aceri tatarici-Quercion* or Al. *Quercion petraeae* (Chifu 2004-2006; Chifu & al. 2006).

Infracoenotaxa within Ass. Quercetum frainetto-cerris Rudski 1949:

- subass. *carpinetosum orientalis* (Knapp 1944) Jovanović 1955: cited from the Gorges of Danube river and south of Mehedinţi Tableland (Roman 1974), where it is conditioned by coenotic or anthropogenic factors, by a selective extraction of the Hungarian oak trees, most often representing the secondary stage of the degradation of these communities; after deforestation, the Oriental hornbeam invades the land, together with its entire companion species (Boşcaiu & al. 1971; Nanii 1975; Sanda & al. 1979; Popescu 1988; Pop & Cristea 2002)
- subass. *tilietosum tomentosae* (Lovász 1995) Pop & Cristea 2002: described from Banat, under the original name of *Querco-Tilietum tomentosae* Lovász 1995 (Lovász 1995; Pop & Cristea 2002)
- subass. *quercetosum petraeae* Coste 1975: described from Locvei Mountains, where *Quercus petraea* become subdominant in Hungarian oak-Turkish oak stands (Coste 1975)
- subass. *geticum* I. Pop 1967 (Syntax. syn.: *Quercetum cerris* Georgescu 1941, *Quercetum farnetto* Păun 1966, *Quercetum cerris-farnetto* Păun 1966, *Lychno coronariae-Quercetum cerris* Sanda & al. 2003): described from Muntenia and Oltenia, where they grow on brown-reddish or forest-brown soils, podzolited, cold, with high compactness, at altitudes of 140-300 m a.s.l., in a climatic region with Mediterranean influences; the dominant species is the Turkish oak, with which appear: *Quercus frainetto, Fraxinus excelsior* and *Staphyllea pinnata*; of the differential species are mentioned: *Asparagus tenuifolius, Ventenata dubia, Helleborus odorus, Comandra elegans, Doronicum hungaricum*, etc. (Georgescu 1941a, b, 1943; Păun 1964; Sanda & Popescu 1971; Popescu & Sanda 1974; Sanda & al. 1979; Popescu & al. 1984)
- subass. *banaticum* I. Pop 1967: described from Banat, includes the Banat and Getic Hungarian oak-Turkish oak stands, which differ from those of Crişana by their more pronounced xerophilic feature, being considered as new regional associations or subassociations, with several local variants, little studied; occupies large areas, on almost all Banat hills, at altitudes of 180-250 m a.s.l., on compact, brown of forest soils, with excessive moisture in the spring and dry in the summer; differential species quoted: *Tilia tomentosa, Fraxinus ornus, Carpinus orientalis, Ruscus hypoglossum, R. aculeatus, Hieracium pavichii*, etc. (Pop 1967; Sanda & al. 1979)
- subass. *crisicum* I. Pop 1967: described from Crişana, on low-inclined piedmont plateaux, situated at west of Tăşad, as isolated clusters isolated or framed by Turkish oak-sessile oak stands, growing under ecological conditions similar to those; the tree layer is dominated by the Hungarian oak, with which only the Turkish oak is better represented; the canopy is of 0.7-0.8; the shrub layer is poorly represented, made of few species, and the herbaceous layer covers the soil approximately equally; the excessive spring and autumn humidity and the cooler climate are evidenced by the presence of some

mesophilous species (e.g., *Festuca heterophylla*, *Carex brizoides*, *C. digitata*, etc.), which distinguish themselves from the Banat and Getic Hungarian oak-Turkish oak stands (Pop 1967; Sanda & al. 1979)

- facies with *Poa nemoralis* Ghişa & Kovács 1963 and facies with *Luzula nemorosa* Ghişa & Kovács 1963: groups the rare and poorer in species Hungarian oak stands from Zarand Mountains, 280-360 m a.s.l., on south and south-east aspects, 15º-20º inclination; phytocoenoses form rare, park-like stands, with consistencies of up to 0.5; beside the dominat-edificator species, other characteristic species of the two facieses are: *Luzula nemorosa*, *Poa nemoralis*, *Cytisus nigricans*, *Genista tinctoria*, *Cruciata glabra, Juniperus communis*, but it is missing *Quercus petraea*, *Q. dalechampii*, etc. (Ghişa & Kovács 1963)
- var. reg. *romanicum* Borza 1966: described from Muntenia, where it was installed on podzolited soils, replacing the phytocoenoses of *Quercus pedunculiflora*, primary phytocoenoses here; are quoted as characteristic species for the south area of Bucharest the next species: *Crocus flavus*, *Ornithogalum fimbriatum*, *Fraxinus angustifolia*, and *Paeonia peregrina* (Borza 1966; Sanda & al. 1979)
- var. reg. *dacicum* Boşcaiu 1970, 1971: are included phytocoenoses installed on the southern slopes, acidophilic substrate, in the area of Ţarcu, Godeanu and Cernei Mountains; these Hungarian oaks stands are an extension to the north of the Danube river of the subass. *moesiacum* (Syntax. syn. *serbicum* Rudski, ap. Horvat 1946), but poorer in thermophylous species; these stands have an intermediate position between Al. *Quercion frainetto* and Al. *Quercion petraeae* (included, however, in Al. *Quercion frainetto* Horvat 1954) (Boşcaiu 1971; Sanda & al. 1979)
- ass. *Carici-Quercetum frainetto* Doniţă 1970: described from north of Dobrogea (Babadag Tableland) (Doniţă 1970), between 90 and 250 m a.s.l., on south, south-east or south-west, rarely on north-east aspects, at the limit of the mesothermic and xerothermic forests, on loess or limestone substrates (on the inclined slopes), on brown-red soils, ± podzolited, deep, very compact in horizon B, poor in humus and medium trophic (Dihoru & Doniţă 1970); there are described subass. *typicum* Dihoru & Doniţă 1970 in north of Dobrogea, with the participation of a group of helio-xerophilous species *(Brachypodium pinnatum, Lychnis ?, Teucrium chamaedrys, Festuca rupicola, Festuca valesiaca* etc.) (Dihoru & Doniţă 1970) and subass. *sessiliflorosum* Dihoru & Doniţă 1970, with the participation of *Quercus dalechampii* and *Q. petraea*, besides of *Q. frainetto*, but without the group of characteristic species of the first subass. (Dihoru & Doniţă 1970)
- ass. *Fragario viridis-Polyquercetum* Doniţă 1970: described from north of Dobrogea (Babadag Tableland), within the xerotermc forests floor, between 30 and 120 m a.s.l., on loess and leached chernozem soil, deep, rich in humus, with high trophicity (Dihoru & Doniţă 1970)
- ass. *Quercetum robori-frainetto* Gh. Popescu 1988: described from Getic Piedmont of Oltenia, between 280 and 360 m a.s.l., on flat or light slopes, on south-west and south-east aspects, where predominate *Q. frainetto* (Popescu 1988)
- ass. *Quercetum frainetto-polycarpae* Gh. Popescu 1988 (Syntax. syn. *Querco petraeae-Carpinetum* Soó & Pocs 1957 *frainettosum* Gh. Popescu 1974, 1975): distributed in Oltenia, in the middle and high parts of the Getic Piedmont and the subCarpathian hills,

between 220 and 520 m a.s.l., on south-west aspects (Popescu 1988)
- ass. *Quercetum frainetto* Păun 1964 (Syntax. syn.: *Quercetum confertae typicum* Paşcovschi & al. 1956, *Quercetum confertae* Borza 1931 n.n.): described from Oltenia (Păun 1964), Muntenia (Paşcovschi & al. 1956; Marcu 1962; Paşcovschi & Doniţă 1967), Banat (Boşcaiu & al. 1971), Zarandului Mountains (Ghişa & Kovács 1963), where it is installed on flat lands or on the southern slopes, on brown forest soils or degraded podzols (of hydrogenesis), with deep groundwater, where water stagnates in spring, in microdepresions, and at the end of summer the herbaceous flora stop the vegetative cycle, the soil being strongly cracked (Sanda & al. 1979, 1998)
- ass. *Quercetum farnetti-petraeae* Bârcă (1973) 1984 (Syntax. syn. *Quercetum farnetti-dalechampii* (Bârcă 1984) Chifu 2004-2006): described from Tutova Hills (Bârcă 1973, 1984) and Cotmeana Tableland (Sanda & al. 1998), on tablelands and sunny slopes, with thr tree layer edyfied by *Q. frainetto* and *Q. petraea* or *Q. dalechampii*, with the shrub layer dominated by *Acer tataricum*, *Staphylea pinnata, Cornus mas*, *Crataegus monogyna*, etc., and the herbaceous layer dominated by mesophylous species, with the predominance of the Eurasian and European species

The aim of this study was to investigate the plant communities edified by the Hungarian oak in Eastern Romania (Moldavia), in correlation with the ones from other regions of Romania, proposing to incorporate them in a coherent phytocoenotic system, reflecting in a high rate the habitat features, the other companion plant species and the syndinamics of the Hungarian oak stands in the Southern part of Moldavia.

Material and Methods

Data collection: field surveys in the study area were performed in different vegetation seasons, in stationary, starting with late spring, and finishing in autumn. The phytocoenological relevés were made following the principles of the Zürich-Montpellier Phytocoenological School (Braun-Blanquet 1964). A number of twelve phytocoenological plots were established in the forest "Tâmpa", near Bursucani village, Galaţi county, while a single plot were established in the forest "Rădeanu", near Căuia de Jos village, Bacău county (Table 1). Each phytocoenological relevé were alloted individual synecological data in the field, such as: surface (in square meters), aspect, slope (in degrees), the elevation (m above sea level), stand consistency (in numbers), tree heights (in meters) and diameters (in centimeters, at breast height), shrub, herbaceous and regenerative layers coverages (in %). The local coordinate positions of each relevé were recorded using a GPS device (Garmin GPSMAP® 60CSx). The size of the relevés (plots) was of 400 square meters.

On the other hand, a set of 287 relevés with Hungarian oak and Turkey oak, representing the presence of these species in various phytoceonologic surveys in Romania (both already published, as well as the author's relevés), were transcripted from published literature and field trips. The relevés were selected on the basis of the following criteria: (a) the two co-dominant species (*Quercus frainetto* and *Q. cerris*) must each have a cover of at least 2 on the Braun-Blanquet's scale; and (b) none of the other vascular plant taxa can

Table 1. Ass. *Quercetum frainetto-cerris* Rudski 1949 subass. *quercetosum dalechampii* subass. nov. ...

Surface of relevé (m^2)			400	400	400	400	400	400	400	400	400	400	400	400	400	
Aspect			SW	SW	SW	S	NW	S	S	S	S-E	E	S	S	E	
Slope (degrees)			10	15	15	3	3	15	15	10	10	7	10	10	5	
Elevation (m a.s.l.)			192	195	190	210	215	198	200	218	220	235	240	245		
Tree layer coverage (%)			1	1	1	0.8	0.75	1	0.8	0.65	0.75 -0.8	0.65	0.7	0.65	0.85	
Tree height (m)			17	16	17	17	18.5	16	18. 5	19	19	15- 18	13- 15	12- 13	8-10	K
Tree diameter (cm)			20- 40	10- 35	10- 40	7- 35	15- 45	15- 35	7- 45	10- 40	10- 45	20- 40	15- 30	15- 35	15- 30	
Shrub layer coverage (%)			1	3	1	2	10	5	2	5	10	30	5	10	25- 30	
Herbaceous layer coverage (%)			5	8	5	5	5	10	5	5	5	20	8	15	5	
Regenerative layer coverage (%)			1	1	1	1	2	1	1	1	1	1	1	1	5	
Rel. no. (in dendrogram)			B1	B3	B4	B5	B6	B7	B8	B9	B10	B12	B13	B14	T1	
Rel. no.			1	2	3	4	5	6	7	8	9	10	11	12*	13	
Char. ass.																
Ph	Balc.	*Quercus frainetto*	4	4	4	4	4	4	4	4	4	4	4	4	4	V
		Quercus frainetto juv.	.	+	+	+	+	+	+	+	+	+	+	+	+	V
Diff. subass.																
Ph	Medit. E-Carp.-Balc.	*Quercus dalechampii*	1	1	1	1	1	1	1	1	1	1	+	+	+	V
		Quercus dalechampii juv.	.	+	+	+	+	+	+	+	+	+	+	+	+	V
Quercion frainetto																
G	Pont.-Medit.	*Asparagus tenuifolius*	+	+	+	+	.	+	+	+	+	+	+	+	+	V
H	Medit.	*Lychnis coronaria*	+	+	.	+	.	.	.	+	+	.	+	+	.	III
H	Balc.	*Symphytum ottomanum*	.	.	.	+	.	.	.	.	+	+	+	+	+	III
Ph	Balc.-Pan.	*Tilia tomentosa*	.	.	.	.	+	.	.	.	+	+	+	1	+	III
		Tilia tomentosa juv.	.	.	.	+	+	.	.	.	+	+	+	1	+	III
H	Eur. C-Smedit	*Potentilla micrantha*	.	.	.	.	.	.	.	.	.	+	+	+	.	II
G	Pont.-Medit.	*Lathyrus venetus*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
Quercetalia pubescenti-petraeae																
G	Eur. C	*Lathyrus niger*	+	+	+	.	.	+	.	.	.	.	+	+	+	III
nPh	Pont.-Medit.	*Cornus mas*	.	.	.	.	.	.	.	.	+	+	.	+	+	II
H	Euras.	*Vincetoxicum hirundinaria* ssp. *hirundinaria*	.	.	+	.	.	.	.	.	.	+	+	.	.	II
H	Euras.	*Tanacetum corymbosum* ssp. *corymbosum*	.	.	.	.	.	.	+	+	+	.	.	+	+	II
H-G	Eur C-Smedit	*Buglossoides purpurocoerulaea*	.	.	.	.	.	.	.	.	.	+	+	.	+	II
Ph	Atl.-Medit.	*Sorbus domestica*	.	+	+	.	.	.	+	.	.	.	+	.	.	II
		Sorbus domestica juv.	.	.	.	.	.	.	+	.	.	.	+	.	.	I
H	Eur. C-V	*Melittis melissophyllum* ssp. *melissophyllum*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
Ph	Eur. C	*Sorbus torminalis*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
		Sorbus torminalis juv.	.	.	.	.	.	.	.	.	.	.	.	.	+	I
nPh	Pont.-Medit.	*Rosa gallica*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
Quercetea pubescentis																
Ph	Euras. cont.	*Acer tataricum*	+	+	+	+	+	+	+	.	+	+	+	+	+	V
		Acer tataricum juv.	+	+	+	+	+	+	+	.	+	.	+	+	.	IV
H-G	Eur. C-Smedit	*Melica uniflora*	.	.	.	+	.	.	.	.	.	+	+	.	1	II
H	Pont.	*Vinca herbacea*	.	.	.	.	.	+	+	+	.	.	+	+	.	II
Ph	Eur.	*Pyrus pyraster*	.	.	.	.	.	.	.	.	.	+	+	+	.	II
		Pyrus pyraster juv.	.	.	.	.	.	.	.	.	.	+	+	.	.	I
nPh	Pont.-Medit.	*Cotinus coggygria*	.	.	.	.	.	.	.	+	.	.	.	.	.	I
H	Euras.	*Primula veris*	.	.	.	.	.	.	.	.	+	.	+	.	.	I
G	Euras.	*Carex filiformis*	.	.	.	.	.	.	.	.	.	.	+	.	.	I

Place and data of releves: 1-9 - forest "Tâmpa", Bursucani village, Galaţi county, Covurlui Hills, 28.05.2010; 10-12 idem, 12.05.2018; 13 - forest "Rădeanu", Căuia de Jos village, Bacău county, Tutova Hills, 12.05.2018.

* holotype releve

Table 1. continued.

T	Euras. cont	*Geranium divaricatum*	.	.	.	.	.	.	.	.	.	.	.	+	.	I
Ph	×	*Quercus* × *pseudopubescens*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
	Rhamno-Prunetea															
nPh	Euras.	*Crataegus monogyna*	+	+	+	+	+	+	1	+	+	2	+	+	+	V
		Crataegus monogyna juv.	+	+	+	.	+	+	+	+	+	.	+	+	.	IV
nPh	Eur.	*Rosa canina*	+	+	.	+	+	+	+	+	+	+	+	+	+	V
		Rosa canina juv.	.	.	+	+	+	+	+	+	+	+	+	.	.	IV
nPh	Eur. (Smedit)	*Ligustrum vulgare*	+	+	.	+	.	+	+	+	+	+	+	.	+	IV
nPh	Eur.	*Prunus spinosa*	+	.	.	.	.	.	.	.	.	.	+	.	+	II
		Prunus spinosa juv.	.	+	.	.	.	+	.	.	.	.	+	.	+	II
nPh	Euras.	*Rhamnus catharticus*	.	.	.	+	+	.	.	.	+	.	.	.	.	II
nPh	Eur. C	*Viburnum lantana*	.	.	.	.	.	.	.	+	+	.	.	.	+	II
nPh	Euras.	*Rosa spinosissima*	.	.	+	.	.	.	.		.	.	.	.	.	I
nPh	Eur. C	*Cornus sanguinea*	.	.	.	.	.	.	.	+	.	.	.	.	.	I
		Cornus sanguinea juv.	.	.	.	.	.	.	.	+	.	.	.	.	.	I
H	Euras.	*Campanula rapunculoides*	.	.	.	.	.	.	.	.	.	.	.	+	+	I
	Carpino-Fagetea															
H	Circ.	*Poa nemoralis*	+	+	+	+	.	1	1	+	+	+	+	+	+	V
H	Euras.	*Brachypodium sylvaticum*	+	+	+	+	+	+	+	+	+	+	+	+	.	V
H	Eur.	*Carex muricata* subsp. *muricata*	+	+	+	+	.	+	+	+	+	+	+	+	+	V
G	Pont.-Pan.-Balc.	*Polygonatum hirtum*	+	+	+	.	+	+	+	+	+	.	.	.	+	IV
Ph	Smedit	*Prunus avium*	+	+	+	.	+	+	+	.	.	+	+	+	+	IV
		Prunus avium juv.	+	+	+	.	+	+	+	+	+	+	+	.	.	IV
Ph	Eur.	*Fraxinus excelsior*	+	+	.	.	.	.	.	+	.	.	.	.	+	II
		Fraxinus excelsior juv.	+	+	.	.	.	.	.	+	+	.	.	.	.	II
H	Euras.	*Stellaria holostea*	+	.	+	.	.	.	.	.	.	.	.	.	+	II
H-Ch	Pont.-Medit.-Eur. C	*Glechoma hirsuta*	+	.	.	.	.	.	.	.	.	+	+	.	+	II
H	Euras.	*Dactylis glomerata* ssp. *lobata*	.	+	.	+	.	.	.	.	+	+	+	.	.	II
H	Eur. C	*Galium schultesii*	.	+	+	+	.	.	.	.	+	.	.	.	+	II
nPh	Eur.	*Euonymus europaeus*	.	.	.	.	+	.	.	.	+	.	+	.	+	II
		Euonymus europaeus juv.	.	.	.	.	+	.	.	.	+	.	+	.	.	II
nPh	Eur. SE	*Euonymus verrucosus*	.	.	.	.	.	.	.	+	.	+	+	.	+	II
Ph	Eur.	*Acer campestre*	.	.	.	.	.	.	.	.	+	+	.	+	+	II
		Acer campestre juv.	.	.	.	.	.	.	.	.	+	+	.	+		II
Ch	Eur.	*Loranthus europaeus*	.	.	.	.	.	.	.	.		+	+	.	+	II
H-G	Euras.-Medit.	*Ranunculus ficaria* ssp. *ficaria*	.	.	.	.	.	.	.	.	.	+	+	+	.	II
Ph	Eur. C	*Carpinus betulus*	.	.	.	.	.	.	.	.	.	+	+	+	.	II
		Carpinus betulus juv.	.	.	.	.	.	.	.	.	+	.	.	+	.	I
Ph	Eur.	*Malus sylvestris*	.	.	.	.	.	.	.	.	+	.	+	.	.	I
Ph	Euras.	*Acer platanoides*	.	.	.	.	.	.	.	.	.	+	.	.	.	I
		Acer platanoides juv.	.	.	.	.	.	.	.	.	.	+	.	.	.	I
H	Euras.	*Carex divulsa* ssp. *divulsa*	.	.	.	.	.	.	.	.	.	+	.	+	.	I
G	Euras.	*Gagea lutea*	.	.	.	.	.	.	.	.	.	+	.	.	.	I
T-Ht	Cosm.	*Geranium robertianum*	.	.	.	.	.	.	.	.	.	+	.	+	.	I
G	Eur. C-Medit.	*Carex brevicollis*	.	.	.	.	.	.	.	.	.	.	+	.	.	I

Table 1.continued.

Ch	Eur.C, V-Smedit	*Euphorbia amygdaloides*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
T-Ht	Euras.-Medit.	*Moehringia trinervia*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
H	Euras.	*Scrophularia nodosa*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
H	Euras.	*Viola reichenbachiana*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
G	Eur.	*Anemone ranunculoides*	.	.	.	.	.	.	.	.	.	.	.	+	+	I
G	Eur.	*Convallaria majalis*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
Ph(l)	Atl.-Medit.	*Hedera helix*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
G-H	Eur.	*Mercurialis perennis*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
H	Eur.	*Mycelis muralis*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
H	Pont.-Medit.	*Scutellaria altissima*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
H	Euras.	*Stachys sylvatica*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
Ph	Euras.	*Ulmus glabra*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
Ph	Eur.	*Ulmus minor* var. *minor*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
	Trifolio-Geranietea															
H	Euras.-Smedit	*Astragalus glycyphyllos*	+	+	+	.	.	.	.	+	+	+	+	+	.	IV
H	Euras.	*Origanum vulgare*	+	+	+	.	.	+	+	+	.	.	.	+	.	III
H	Euras.	*Agrimonia eupatoria*	+	.	.	.	.	.	.	.	.	+	+	+	.	II
H-Ch	Euras.	*Veronica chamaedrys* ssp. *chamaedrys*	+	.	.	.	.	.	+	.	.	.	.	+	.	II
G	Euras.-Medit.	*Polygonatum odoratum* ssp. *odoratum*	.	.	.	.	.	.	.	.	.	+	+	+	.	II
H	Euras.	*Vicia sylvatica*	.	+	.	.	.	.	.	.	.	.	.	.	.	I
H	Eur. C	*Trifolium ochroleucon*	.	.	.	.	.	+		.	.	.	.	.	.	I
H	Euras. cont.	*Inula hirta*	.	.	.	.	.	.	+	.	.	.	.	.	.	I
H	Euras.	*Galium mollugo*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
H	Euras.	*Silene nutans* ssp. *nutans*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
H	Euras.	*Stachys officinalis*	.	.	.	.	.	.	.	.	.	.		.	+	I
	Galio-Urticetea															
T	Circ.	*Galium aparine*	+	+	.	+	+	+	.	+	+	+	+	+	+	V
H	Circ.	*Geum urbanum*	+	+	.	+	+	+	+	+	+	+	+	+	+	V
T-H	Euras.	*Lapsana communis*	+	.	+	.	.	+	+	+	+	+	+	+	.	IV
H	Cosm.	*Urtica dioica* ssp. *dioica*	.	.	+	+	+	.	+	+	.	+	+	+	.	IV
T	Pont.-Medit.	*Anthriscus cerefolium* ssp. *trichosperma*	+	.	.	.	+	.	.	.	.	+	+	+	.	II
Ht-H	Euras	*Alliaria petiolata*	.	.	+	+	+	.	.	.	.	+	.	.	+	II
Ht	Eur.	*Chaerophyllum temulentum*	.	.	.	.	.	.	.	.	.	+	.	+	.	I
	Festuco-Brometea															
H	Euras.	*Hypericum perforatum*	+	+	.	+	.	+	.	.	+	+	+	+	.	IV
H	Euras.	*Viola hirta*	+	.	+	+	.	.	+	.	.	+	+	+	+	IV
H	Euras. cont.	*Verbascum phoeniceum*	.	+	.	+	.	+	+	+	+	+	+	.	.	IV
G	Eur. C.-Smedit	*Ornithogalum orthophylllum* ssp. *kochii*	.	.	.	.	.	.	+	+	+	+	+	+	.	III
H	Euras.	*Fragaria viridis* ssp. *viridis*	+	+	.		.	+	.	.	.	.	+	.	+	II
H	Euras.	*Euphorbia cyparissias*	.	+	.	+	.	+	.	.	.	.	+	.	.	II
H	Euras. cont.	*Thalictrum minus*	.	.	.	+	.	.	.	.	.	+	+	.	.	II
H	Euras.	*Poa angustifolia*	.	.	.	.	.	.	+	+	.	+	+	.	.	II
Ch	Eur. C-Smedit	*Teucrium chamaedrys*	.	.	.	.	.	+	.	.	.	.	+	.	.	I
H	Eur. C, E	*Pilosella piloselloides* ssp. *piloselloides*	.	.	.	.	.	.	+	.	.	.	.	.	.	I
H	Euras. cont.	*Achillea setacea*	.	.	.	.	.	.	.	+	.	.	.	.	.	I
H	Eur.-Medit.	*Achillea seidlii*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
G	Euras. cont	*Carex praecox*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
Ht-H	Euras. cont.	*Chondrilla juncea*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
H	Pont.-Medit.	*Eryngium campestre*	.	.	.	.	.	.	.	.	.	.	+	.	.	I

Table 1. continued.

H	Euras. cont.	*Festuca valesiaca*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
H	Euras.	*Galium verum*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
T	Pan.	*Melampyrum barbatum*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
G	Eur.	*Muscari comosum*	.	.	.	.	.	.	.	.	.	.	.	+	+	I
H	Eur. C, E	*Pilosella piloselloides* ssp. *bauhinii*	.	.	.	.	.	.	.	.	.	.	+	+	.	I
H	Euras.	*Poa bulbosa*	.	.	.	.	.	.	.	.	.	.	.	+	.	I
H	Euras. cont	*Poa compressa* ssp. *compressa*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
Ch	Pont.-Pan.	*Thymus pannonicus* ssp. *pannonicus*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
T	Pont.-Medit.	*Trifolium diffusum*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
T	Eur.	*Valerianella locusta*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
Ht	Eur.	*Verbascum lychnitis*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
	Molinio-Arrhenatheretea															
H	Eur.	*Ajuga reptans*	+	+	+	+	+	.	+	+	+	+	+	+	.	V
H	Euras.-Smedit	*Valeriana officinalis* ssp. *officinalis*	.	.	.	.	.	.	.	+	.	+	.	.	+	II
H	Euras. (Smedit)	*Carex distans*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
H	Cosm.	*Prunella vulgaris*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
H	Euras.	*Mentha* × *dumetorum*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
H	Euras.	*Plantago major* ssp. *major*	.	.	.	.	.	.	.	.	.	.	.	+	.	I
H-Ch	Euras.	*Lysimachia nummularia*	.	.	.	.	.	.	.	.	.	.	.	.	+	I
	Aliae															
T	Circ.	*Fallopia convolvulus*	+	+	+	+	+	+	+	+	+	+	+	.	.	V
T	Euras.	*Lamium purpureum*	+	.	.	+	+	.	+	.	.	+	.	.	.	II
T	Euras.	*Vicia tetrasperma*	+	+	+	.	.	.	+	.	.	.	.	.	.	II
H	Euras.	*Tanacetum vulgare*	+	.	.	.	.	.	+	.	.	.	.	.	.	I
Ht	Euras.-Smedit	*Verbascum blattaria*	+	.	.	.	.	.	.	.	.	.	.	.	.	I
T	Euras.	*Geranium columbinum*	.	.	.	.	+	.	.	.	.	.	.	.	.	I
H	Eur.	*Sedum telephium* ssp. *maximum*	.	.	.	.	.	.	+	.	.	.	.	.	+	I
H	Circ.	*Artemisia vulgaris*	.	.	.	.	.	.	.	+		.	.	.	.	I
H	Euras.	*Taraxacum officinale*	.	.	.	.	.	.	.	.	+	.	.	+	.	I
T-Ht	Cosm.	*Stellaria media*	.	.	.	.	.	.	.	.	.	+	+	.	.	I
T	Euras.	*Veronica hederifolia* ssp. *hederifolia*	.	.	.	.	.	.	.	.	.	+	.	.	.	I
T	Euras.-Medit.	*Bromus sterilis*	.	.	.	.	.	.	.	.	.	+	.	+	.	I
T-Ht	Cosm.	*Arabidopsis thaliana*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
Ht-H	Circ.	*Erigeron acris*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
H	Eur. C	*Geranium phaeum*	.	.	.	.	.	.	.	.	.	.	+	+	.	I
T	Eur.	*Geranium pusillum*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
H	Euras.	*Potentilla argentea*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
H	Euras.	*Rumex crispus*	.	.	.	.	.	.	.	.	.	.	.	+	.	I
T	Euras.	*Vicia hirsuta*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
T	Euras.	*Viola arvensis*	.	.	.	.	.	.	.	.	.	.	+	.	.	I
T	Euras. cont.	*Bromus tectorum*	.	.	.	.	.	.	.	.	.	.	.	+	.	I
H	Euras.	*Plantago lanceolata*	.	.	.	.	.	.	.	.	.	.	.	+	.	I
T	Medit.	*Vicia striata*	.	.	.	.	.	.	.	.	.	.	.	.	+	I

reach more than two on the same cover scale. Bryophytes and lichens were excluded from the table, because they were not recorded in all field relevés.

The names of vascular plant taxa used herein are consistent with the current online version of the Flora Europaea (http://Euro+Med PlantBase 2006 onwards). The diagnostic plant species of vegetation classes in this paper follow the catalogue of European classification (Mucina 1997), while the diagnostic plant species for alliances and orders follow the most recent paper over the Romania's vegetation (Coldea & al. 2015).

The dendrogram has been done by cluster analysis using PC-ORD software using the presence-absence of species within the each relevé, with the Sorensen (aka Bray-Curtis) distance measured and the group average linkage method (Peck 2010).

Results

The phytosociological researches carried out on *Q. frainetto* forests in "Tampa" forest, Bursucani village (between 2010 and 2018) and "Rădeanu" forest, Căuia de Jos village (in 2018), led to the description of a new subassociation, namely ***quercetosum frainetti*** subass. nov., framed in Ass. *Quercetum frainetto-cerris* Rudski 1949.

The coenotaxonomic framing of these stands is:

Cl. *Quercetea pubescentis* Doing-Kraft ex Scamoni & Passarge 1959

Ord. *Quercetalia pubescenti-petraeae* Klika 1933, corr. Moravec in Béguin & Theurillat 1984

Al. *Quercion frainetto* Horvat 1954

As. *Quercetum frainetto-cerris* Rudski 1949

subass. ***quercetosum dalechampii*** subass. nov.

Holotype: relevé No. 12 (Table 1)

The stands framed in this newly proposed infracoenotaxon are located in the south of Moldova, at the contact between the nemoral floor and the forest-steppe zone, in the western part of the Covurlui Hills ("Tampa" forest, Bursucani village) and the eastern part of the Tutova Hills ("Rădeanu" forest, Căuia de Jos village), being distributed on plateaux or on gentle slopes (3° -15°), at altitudes of 180 m - 230 m a.s.l. ("Tampa" forest), 230 m - 400 m a.s.l. ("Rădeanu" forest), on sunny aspects (south, south-west, south-east, east).

The floristic composition and structure of the new proposed subassociation are presented in Table 1. The total number of species in the floristic composition of the subassociation is 144, on each relevé there are recorded between 20 and 82 species, with an average (± SD) of 38.7 ± 17.2.

Of the two co-edificator species of ass. *Quercetum frainetto-cerris* Rudski 1949, only *Quercus frainetto* is present in relevés, a species that dominate the tree layer (AD=4), whereas *Q. cerris* is absent in all phytocoenoses.

As characteristic (good diagnostic) species of the new subassociation, the following are distinguishable: *Quercus dalechampii* (east Medit.-Carp.-Balc.), *Symphytum ottomanum* (Balc.), *Ornithogalum orthophylllum* subsp. *kochii* (central Eur.-subMedit), *Vinca herbacea* (Pont.), *Sorbus domestica* (Atl.-Medit.) and *Carex muricata* subsp. *muricata* (Eur.).

Structure: the new subassociation proposed here reflects adequately the local site conditions, as well as the existence of some characteristic phytotaxa of this area (located at the

border between Tutovei Hills and Covurlui Tableland). Thus, phytocoenoses are not compact, the overall coverage being generally of 80-85%. The trees layer is a single-layered one, with a medium to high consistency, ranging from 0.65 to 1.0, with heights between 12 m and 19 m and diameters between 7 cm and 45 cm. This layer is dominated by *Quercus frainetto*, while *Q. dalechampii* is a subdominant species or it is only as present. Other tree species (sub)-constant in the tree layer are *Acer tataricum* (V+), *Tilia tomentosa* (III+-1) and *Prunus avium* (IV+). The shrub layer has variable developments, with coverages between 1% and 30%, the more frequent being *Crataegus monogyna* subsp. *monogyna, Rosa canina* sensu lato and *Ligustrum vulgare*, with which appear sporadically *Cornus mas, C. sanguinea*, *Prunus spinosa* subsp. *spinosa, Rhamnus catharticus, Viburnum lantana, Euonymus europaeus, E. verrucosus* etc. The herbaceous layer also has variable coverages, depending on the slope aspects, between 5% and 20% (Table 1), frequently being: *Asparagus tenuifolius*, *Brachypodium sylvaticum*, *Poa nemoralis*, *Ajuga reptans*, *Geum urbanum*, *Fallopia convolvulus*, *Carex muricata*, *Polygonatum hirtum, Astragalus glycyphyllos*, *Galium aparine, Viola hirta*, *Urtica dioica*, as well as *Symphytum ottomanum*, *Ornithogalum orthophyllum* subsp. *kochii*, *Lychnis coronaria* etc.

The share in the floristic structure of the diagnostic species for higher syntaxa (Al. *Quercion frainetto*, Ord. *Quercetalia pubescenti-petraeae*, Cl. *Quercetea pubescentis*) varies from a phytocoenosis to another one, between 17.1 to 26.5% (relevé B1, and relevé B10 respectively). The other species belong to other vegetation classes, among which *Carpino-Fagetea* (15.6-38.2%), *Festuco-Brometea* (up to 25.6%), *Galio-Urticetea* (up to 25.0%), *Rhamno-Prunetea* (up to 15.6%) and *Trifolio-Geranietea* (up to 12.5%).

In the structure of the **live's forms** dominants are hemicriptophytes (H=46.5%), the phanerophytes (Ph=21.5%) and the terophytes (T=15.3%), the consistency presence of the later reflecting a rather high level of anthropogenic impact in these Hungarian oak stands (Fig. 1).

The **phytogeographic** structure is dominated by the Eurasian elements (41.3%, of which 7.7% are continental ones) and European (23.1%). There is, however, an important participation in the floristic structure of the meridional elements s. l. (cumulativ ca 28%), like: *Quercus frainetto*, *Symphytum ottomanum* (Balc.), *Tilia tomentosa* (Balc.-Pan.), *Quercus dalechampii* (E Medit.-Carp.-Balc.), *Vinca herbacea* (Pont.), *Asparagus tenuifolius*, *Cornus mas*, *Cotinus coggygria*, *Eryngium campestre* (Pont.-Medit.), *Glechoma hirsuta* (Pont.-medit.-centr. eur.), *Lychnis coronaria* (Medit.), *Prunus avium* (Submedit), *Sorbus domestica* (Atl.-Medit.), *Buglossoides purpurocaerulea*, *Melica uniflora*, *Ornithogalum orthophyllum* subsp. *kochii*, *Potentilla micrantha* (Centr. eur.-submedit), *Euonymus verrucosus* (South-East Eur.), etc. (Fig. 2).

Synecology. From the analysis of species preferences for different ecologic factors, the phytocoenoses of this subassociation are generally subheliophylous (L curve), mesothermophylous (T-curve), xeromesophylous (-mesophylous) (U-curve) and (weakly acid-) neutrophylous (R curve). An important number of species have a wide ecologic tolerance to soil *p*H (27.2%) or to temperature (20.0%) (Fig. 3). The phytocoenoses grow on brown soils and ash-forest soils formed on loessoid deposits rebuilt, in the Covurlui Hills (Sârbu 1979) or on succession of clays, sandy clays and sands in Tutova Hills (Bârcă 1973), slightly podzolited, *p*H=5-6 (rarely <5), with humus = 1.5-6% in the horizon A, the degree of saturation in bases in the horizon A = 66-80% (Bârcă 1973, Sârbu 1979).

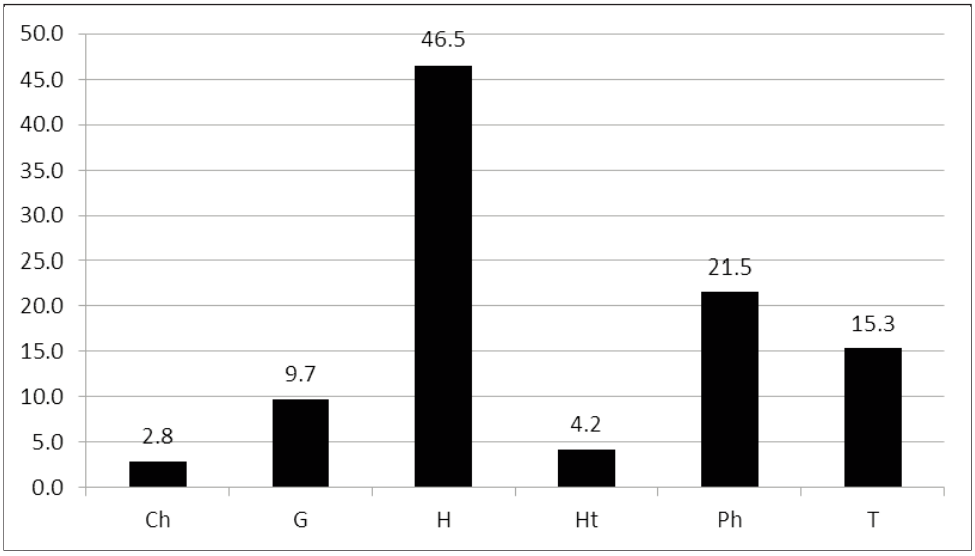

Fig. 1. Plant bioforms of Ass. *Quercetum farnetto-cerris* Rudski 1949 subass. *quercetosum dalechampii* subass. nov.

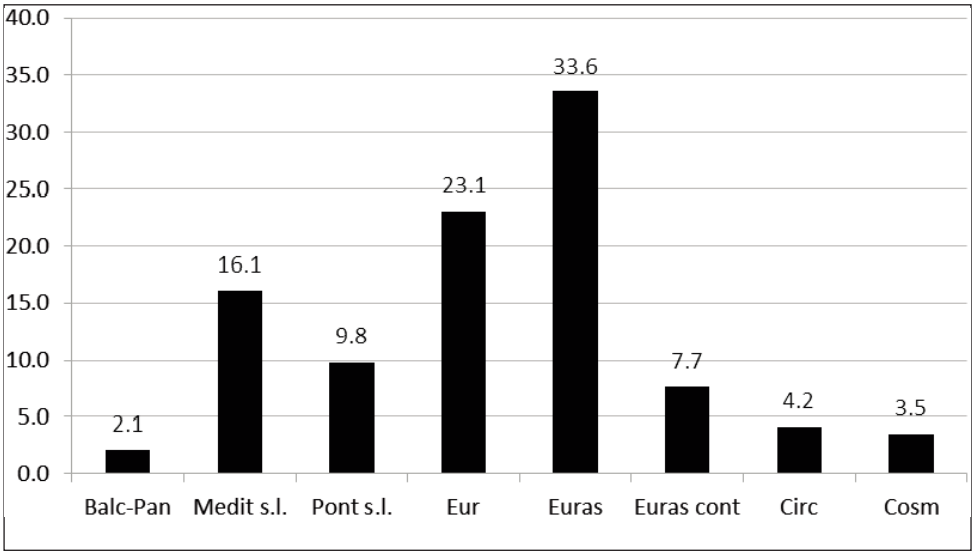

Fig. 2. Phytogeografic elements of Ass. *Quercetum frainetto-cerris* Rudski 1949 subass. *quercetosum dalechampii* subass. nov.

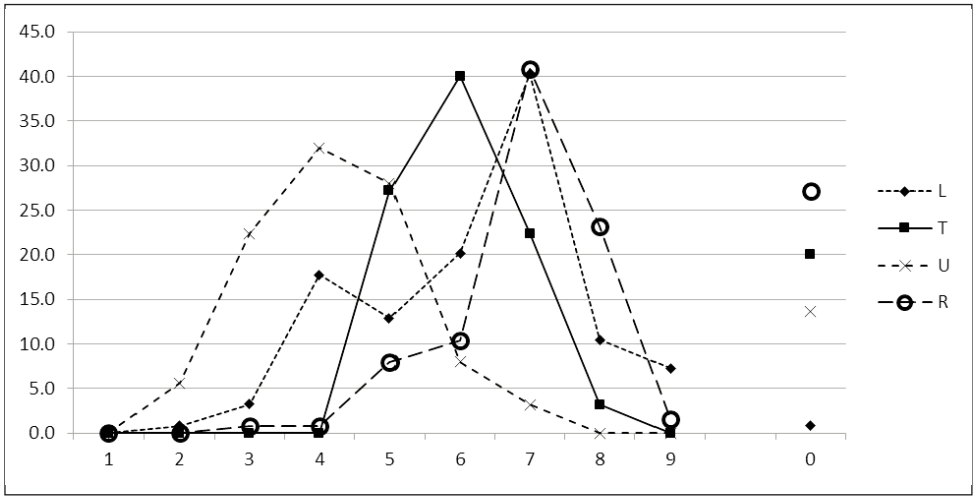

Fig. 3. Ecological spectrum of Ass. *Quercetum frainetto-cerris* Rudski 1949 subass. *quercetosum dalechampii* subass. nov.

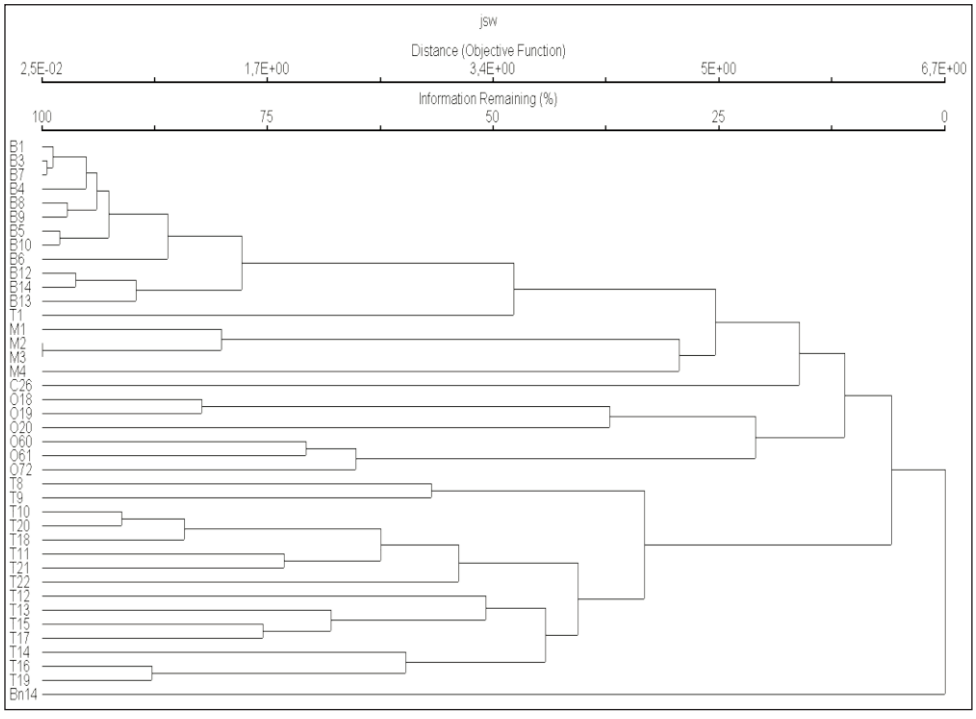

Fig. 4. Hierarchical classification of different forest communities dominated by *Quercus frainetto* in Romania (B=forest "Tâmpa", Bursucani village, Galaţi county, and forest "Rădeanu", Căuia de Jos village, Bacău county; M=Muntenia; C=Crișana; O=Oltenia; T=Tutova Hills; Bn=Banat).

The climatic factors that determine the existence of the Hungarian oak stands on Covurlui Hills are (according to the Balinteşti meteorological station, about 12 Km east of the "Tâmpa" forest, 120 m a.s.l.): the average annual temperature of +9.9ºC, multiannual average rainfall of 529 mm, the absolute minimum temperature of –27.7ºC, the absolute maximum temperature of +37.7 ºC (Sârbu 1978). On the Tutova Hills, for the "Rădeanu" forest, the climatic data are quoted according to the meteorological station of Bârlad town: the average annual temperature is 9.8ºC, the multiannual average rainfall is of 588 mm (Bârcă 1973).

The individuality of the Hungarian oak stands in south of Moldova, compared to those in other regions of Romania, is also proved by the cluster analysis, as it is shown below (Fig. 4).

Discussion

In Romania, the penetration of the Hungarian oak stands towards north is limited by winter temperatures, too low for the survival of the species. This limit is marked by the annual isotherm of +10ºC, with the isotherm of July +21 ºC and the January isotherm of –2ºC. On southern slopes and plateaux, with dry and drained deep soils, the Hungarian oak forward insularly up to the annual isotherm of +9 ºC, the isotherm of July +20 ºC and the isotherm of January –3ºC. Toward south and east, to the forest-steppe, the spread limit of the Hungarian oak coincides with the annual isotherm of +11 ºC, the isotherm of July +23 ºC and the isotherm of January –3 ºC. The absolute maximum temperature in Romania was of +42.9 ºC, and the absolute minimum of –34.8 ºC, thus a thermal amplitude of 77.7 ºC (Marcu 1962).

The average annual rainfall in the area of the Hungarian oak ranges from 491.5 mm to 715 mm, with a peak in June, followed by a long dry period in which the soil is dry and deeply cracked. The dry years follow at different intervals, being marked by very low precipitation, which can go down to 275 mm (Marcu 1962; Roman 1974; Pop & Cristea 2002).

The soils are formed on fine alluviums, deposited over the Romanian gravels, loessoid deposits or degraded loess, of the following types: strong and very strong leached chernozem, brown-reddish of forest, brown of forest (weak, medium and strongly podzolited) and secondary podzols, all with clayey and loam-clayey texture in B horizon, with Ca carbonates at depths above 1.20-1.50 m.

The Hungarian oak does not benefit from the groundwaters, which are at very high depths (over 100 m) on the plateaux and never descends into valleys, where meadow forests and *Quercus robur* stands are frequently formed.

Regarding the distribution on various relief forms, at the northern boundary, the Hungarian oak is found in the upper third of the slopes with south exhibitions and on ridges; in the optimal vegetation prevails on the plateaux and all the aspects; at the south limit is placed on the slopes with northern aspects.

In *the hilly area* there are forest stands in which the Turkey oak is predominantly mixed with the Hungarian oak, and where the last species is in regression due to the anthropogenic factor, but there are also other stands on plateaux, where the Hungarian oak forms pure

stands on large areas, having a great stability (as it is in Seaca-Optăşani forest, Olt county) (Paşcovschi & Leandru 1958).

In the *forestry zone* there are forests where the Hungarian oak mixes with the sessile oak, less with the Turkey oak and the beech (*Fagus sylvatica*). Sometimes, the Hungarian oak is obviously mixed with the Turkey oak, the sessile oak and the beech. Sometimes, there are mixed forests of sessile oak, with remnants of forests of Hungarian oak and Turkey oak.

In the *forest-steppe zone*, the Hungarian oak forests are most often insular, being in regression, on the one hand as a result of the penetration of the sessile oak, but there are still stable areas due to local conditions of aspects and soils, and on the other hand due to the anthropogenic factor (selective cuttings of Hungarian oak, as it is in Banat) (Boşcaiu & al. 1971).

In southern Romania, the forests of the Hungarian oak or of the Hungarian oak and Turkey oak are characterized by species adapted to pronounced xerophytism. These species occupy the surfaces with compact and very dry soils, especially in late summer and autumn. The average annual high temperature (+10 ºC... +11 ºC) and especially during the vegetation period (+18 ºC), low rainfall (500-600 mm), as well as the soil structure (brown-reddish of forest in different stages of leaching) are the conditions that favor the installation of a vegetation with many subMediterranean elements. Thus, the Hungarian oak stands in Oltenia have in the floristic composition different southern species, such as: *Vicia sparsiflora*, *Comandra elegans*, *Erythronium dens-canis* subsp. *niveum, Helleborus odorus, Paeonia peregrina, Asparagus tenuifolius, Acanthus balcanicus, Viola jordanii*, *Trifolium echinatum*, *Asperula taurina* subsp. *leucanthera*, *Rosa corymbifera*, *R. gallica*, etc. (Păun 1964; Nanii 1975); the forests of Muntenia include *Quercus pedunculiflora*, while the forests of Dobrogea and Banat have the Oriental hornbeam (*Carpinus orientalis*).

In Eastern Romania, the forests of Hungarian oak are distributed in the southern half of Moldavia only, settled in the forest-steppe zone (forest "Tâmpa", near Bursucani village, Galaţi county), and in some cases reach even the lower part of the beech belt of vegetation, in hilly zone, between 230-400 m a.sl., on plateaux or on sunny slopes, with south, east or west aspects, inclined at 5° -30°, in the *Q. robur* area and in the lower part of the beech floor, as it is in the Tutova hills (Bârcă 1969, 1971, 1973, 1984).

Most of the cases, the Hungarian oak is found as isolated specimens in various forest types, e.g. in sessile oak stands, sessile oak-hornbeam stands, oak-hornbeam stands, hornbeam-beech stands, blackthorn with hawthorn (included in ass. *Pruno spinosae-Crataegetum*), etc. However, in some stands within Tutova Hills, the Hungarian oak manages to build stands, as they are in the forest "Pătraşcu" (Blaga village), forest "Rădeanu" (Căuia de Jos village), forest "Lepădatu" (Tăvădăreşti village) or in the forest "Valea Rea" (village of Bodeasa) (Bârcă 1969).

In Moldova, the Hungarian oak grows and develops more or less difficult, along with other forestry species (oak, white oak, sessile oak, *Q. pedunculiflora*, hornbeam, beech, lime, aspen, etc.), randomly fructifying and rarely annually. Sometimes, the Hungarian oak manages to reach impressive dimensions and to fructify annually, as in the forest "Leonatu" (Fundătura-Frumuşelu village), forest "Pătraşcu" (Blaga village), forest "Rădeanu" (Căuia de Jos village), forest "Lepădatu" (Tăvădăreşti village) or forest "Valea Rea" (Găiceana village), where trees can reach and exceed 12-15 m in height and diame-

ters over 30-35 cm, where there are trees in different stages of growth (as seedlings, young trees, adult trees and old trees) (Bârcă 1969).

The existing phytocoenoses with Hungarian oak in Moldova, from phytosociological point of view are framed as:

i) in ass. *Quercetum* (*Querco* in orig.) *farnetti-petraeae* Bârcă 1984, Al. *Aceri tatarico-Quercion* Zólyomi & Jakucs 1957, Ord. *Quercetalia pubescenti-petraeae* Klika 1933, Cl. *Querco-Fagetea* Br.-Bl. & Vlieger 1937 em. Sóo 1964 (Bârcă 1984)

ii) in ass. *Quercetum frainetto-petraeae* Bârcă 1973 subass. *dalechampietosum* Mititelu & al. 1993 nom. nudum, în Al. *Quercion frainetto* Horvat 1954, Ord. *Orno-Cotinetalia* Jákucs 1960, Cl. *Quercetea pubescenti-petraeae* (Oberd. 1948) Jákucs 1960 (Mititelu & al. 1993)

iii) in ass. *Querco frainetto-dalechampii* (Bârcă 1984) Chifu & al. 2006, Al. *Aceri tatarico-Quercion* Zólyomi 1957, Ord. *Quercetalia pubescentis* Klika 1933, Cl. *Quercetea pubescentis* Doing-Kraft ex Scamoni & Passarge 1959 (Chifu & al. 2006)

iv) in ass. *Tilio tomentosae-Quercetum dalechampii* Sârbu 1978, Al. *Quercion frainetto* Horvat 1954, Ord. *Quercetalia pubescenti-petraeae* Klika 1933, corr. Moravec in Béguin & Theurillat 1984, Cl. *Quercetea pubescentis* Doing-Kraft ex Scamoni & Passarge 1959 (Indreica, in Coldea & al. 2015).

Considering that until now, framing of the Moldavian phytococenosis with Hungarian oak in syntaxa (in three different associations, two alliances, three orders, three classes) is quite different, the comparative analysis of the "Tâmpa" and "Rădeanu" forests were compared with other phytocoenoses from Moldova, but also from other regions of Romania, phytocoenoses already described in the literature (Bârcă 1984; Mititelu & al. 1993; Chifu & al. 2006; Indreica, in Coldea & al. 2015).

In the original paper, within the ass. *Quercetum frainetto-petraeae*, described from the Tutova Hills (Bârcă 1973, 1984), *Quercus dalechampii* is present only with low AD indices (+) and in the relevés made by the authors of the present study in "Tampa" and "Rădeanu"forests, this is a codominant species with *Q. frainetto*.

Analyzing critically the published relevés from the Tutova Hills (Bârcă 1973, 1984) compared to the relevés from Covurlui Hills, we came to the conclusion that it is appropriate to revise the phytocoenotic framing of the Hungarian oak stands from the eastern part of Romania (in Moldova region).

Arguments for classification of the Hungarian stands in Moldavia in Ass. Quercetum frainetto-cerris *Rudski 1949*

The framing of the Hungarian stands analyzed by us within the ass. *Quercetum frainetto-cerris* Rudski 1949 is justified for the following reasons:

i) one of the diagnostic species (according to Indreica, in Coldea & al. 2015) of this association (*Quercus frainetto*) is present as a dominant species in the tree layer of the analyzed phytocoenoses. There are, also well represented, other diagnostic species/subspecies of the higher syntaxa, as: *Asparagus tenuifolius, Lathyrus venetus, Lychnis coronaria, Potentilla micrantha, Symphytum ottomanum, Tilia tomentosa* (for Al. *Quercion frainetto*), *Buglossoides purpurocoerulaea, Cornus mas, Lathyrus niger, Melittis melissophyllum* subsp. *melissophyllum, Rosa gallica, Sorbus domestica, S. torminalis, Tanacetum corym-*

bosum subsp. *corymbosum, Vincetoxicum hirundinaria* subsp. *hirundinaria* (for Ord. *Quercetalia pubescenti-petraeae*), *Acer tataricum, Carex filiformis, Cotinus coggygria, Geranium divaricatum, Melica uniflora, Primula veris, Pyrus pyraster, Quercus × pseudo-pubescens, Vinca herbacea* (for Cl. *Quercetea pubescentis*) (Table 1)

ii) although *Q. cerris*, one of the edificator species of this association, is lacking in southern part of Moldova, the Hungarian oak stands without *Q. cerris* belonging to the ass. *Quercetum frainetto-cerris* Rudski 1949 have also been reported from other regions of the country, such they are in Oltenia (Păun 1964, Popescu 1988, Popescu & al. 2005), Crişana (Ghişa & Kovács 1963), or in Muntenia (Sanda & Popescu 1971, Popescu & al. 1984)

iii) the lack of the *Q. cerris* in south of Moldova could be dated relatively recent, due to the intense deforestation that has occurred here in the last centuries; there are indications that this tree was still present in Moldova in the nineteenth century, being quoted from Bârlad, Galaţi and Focşani by Szabo (1841-1842), with subsequent takeovers in Kanitz (1879-1881) and Brândză (1879-1883), and even more recently (Răvăruţ & al. 1958). Although these data could not be confirmed in the last half century by herbal materials or by field studies, there are no grounds for considering them as unlikely, as many other species of meridional origins are present in the flora of Moldova; according to data published by Chifu & al. (2006), ca 8% of the vascular flora of this province are meridional (4.05% Medit.-subMedit., 2.67% Pont., 1.37% Balc, etc.). And, if we accept that the presence of *Q. cerris* in South of Moldova was possible in the past, it certainly participated in the floristic structure of some plant communities quite similar to those from the southern part of Romania. From this perspective, it is clear that the Hungarian oak stands in south of Moldavia analyzed here have relic features (also, revealed by their insular presence in here), being probably vestiges of forests, perhaps much more extensive in the past; the closest localities with *Q. frainetto* are in Muntenia, along the Nişcov river valley (Paşcovschi 1937)

iv) the natural conditions in which these forest stands analyzed here (as sunny aspects, slopes with low declivity, alternating hydric regim soils, average annual temperatures of +9.9 ºC, average annual rainfall of ca 530 mm, etc.) are quite similar to those in which they grow the Hungarian oak-Turkey oak stands in the south and west of Romania (as these were presented in the *Introduction* section)

v) the phytocoenoses of Hungarian oak in “Tâmpa” forest, Bursucani village, have xero-mesophilic features, with over 60 species having humidity indexes between 4 and 5 (according to Sârbu & al. 2013); in the floristic composition an important role is played by the characteristic species of Cl. *Quercetea pubescentis*.

In structure of the analyzed phytocoenoses by the authors of this study in South of Moldova there is a significant number of diagnostic species for the forest communities of Cl. *Carpino-Fagetea* (mainly those from Ord. *Fagetalia*) with which they come in contact at higher altitudes (see section *Results*). In Ord. *Quercetalia pubescenti-petraeae* (xerophilous and thermophilous woods in the sub-Mediterranean regions of Europe), this significant participation of the mesophylous species is characteristic to those communities framed in Al. *Aceri tatarici-Quercion* (xerotermic forests of the forest-steppe zone) or to Al. *Quercion petraeae* (xerothermic forests of the subcontinental climate, on slightly acidic soils) revealing their extrazonal feature, within the mesophilic forests’ climate (Indreica, in Coldea & al. 2015). However, the Al. *Quercion frainetto* (subtermophilous

forests of Hungarian oak and Turkey oak, from the sub-Mediterranean climate regions of the Balkan Peninsula) is the best represented in the floristic structure of phytocenoses in South Moldavia (7 species) (Table 1), while the other two alliances are represented by two or three diagnostic species (*Acer tataricum* and *Carex praecox*, respectively *Stachys officinalis*, *Inula hirta* and *Sedum telephium* subsp. *maximum*). In addition, the dominant-characteristic species of the forest communities within the Al. *Aceri tatarici-Quercion* and Al. *Quercion petraeae* (*Quercus petraea*, respectively *Q. robur*, *Q. pedunculiflora* and *Q. pubescens*) are missing in the Hungarian oak stands in south of Moldavia. All these considerations, in the opinion of the authors of the present study, are solid arguments for the classification of these Hungarian oak stands within Ass. *Quercetum frainetto-cerris* Rudski 1949, Al. *Quercion frainetto* Horvat 1954.

Need to describe a new infracoenotaxon within Ass. Quercetum frainetto-cerris *Rudski 1949*

Considering the extent of the territory in which the Hungarian oak-Turkey oak stands are present in Romania, as well as the heterogeneity of the habitats in different regions of the country, naturally there are differences in the floristic structure, which has led to the description of several subassociations, variants or facieses, as it was shown in the Introduction, currently formally unrecognized (Indreica, in Coldea & al. 2015). In a recent synthesis over the forest vegetation in Romania it is stated that on the same unit of relief, the pure forests of *Q. frainetto* or *Q. cerris* do not differ from floristic point ov view of other mixed forests, which is why their separation must be do at the level of facies (Indreica, in Coldea & al. 2015).

However, from the analysis of the Hungarian oak stands existing in eastern Romania (Moldova), it was found that they differ from Hungarian oak-Turkey oak stands from the other provinces through a series of floristical and ecological peculiarities that justify, according to the authors of this study, their separation at the level of subassociation, namely: the presence of some differential species belonging to a new infracenotaxon, such as: the Balkan oak (*Quercus dalechampii*) - subdominant in some phytocoenoses, *Sorbus domestica* (in the tree layer), *Carex muricata* subsp. *muricata*, *Symphytum ottomanum*, *Ornithogalum orthophylllum* subsp. *kochii* and *Vinca herbacea* (in the herbaceous layer) the absence of the Turkey oak (*Q. cerris*) and of other species relatively common in the Hungarian oak-Turkey oak stands in south and west parts of Romania, as: *Aremonia agrimonioides, Carpinus orientalis, Digitalis lanata, Dioscorea communis* var. *communis, Euphorbia polychroma, Helleborus odorus, Luzula forsteri, Ornithogalum fimbriatum, Paeonia peregrina, Prunus mahaleb, Ruscus aculeatus, Sedum cepaea*, etc. (Indreica, in Coldea & al. 2015) an important participation (15.6-38.2%) of a core of characteristic species for Cl. *Carpino-Fagetea* (mainly from Ord. *Fagetalia sylvaticae*) although the prevalence of xerophilous-xeromezophylous species (ca 55% of the species) predominates, there is a significant participation (28%) of the mesophilous species in the floritic structure (Fig. 3), which largely reflects the influence of the mesophilous forests in Ord. *Fagetalia sylvaticae*, with which these phytocoenoses are in contact low coverages of shrub and herbaceous layers, but the relatively low number of meridional species in southern Hungarian oak stands of Moldavia is probably a consequence of a continental climate in

eastern Romania, with quite high thermal amplitudes and very cold winters (Climatic Atlas 1966).

Relations with other forest communities in neighboring regions

The forest phytocoenoses dominated by the Hungarian oak and the Balkan oak (*Q. petraea* sensu stricto) on the south-eastern border of the nemoral floor of the Tutova Hills, were described by Bârcă (1973, 1984) as a new plant community, under the name of "*Querco farnetti-petraeae*" and framed out within Al. *Aceri tatarico-Quercion* Zólyomi 1957 (Bârcă 1973, 1984). Later on, the plant community described by Bârcă was taken over in the literature with the change of the name in "*Quercetum frainetto-petraeae* Bârcă 1973" (Mititelu & al. 1993), "*Querco frainetto-dalechampii* Bârcă 1984" (Chifu & al. 2006) or "*Quercetum frainetto-dalechampii* Bârcă 1984" (Chifu & al. 2014), possibly with framing in an other alliance, namely *Quercion frainetto* Horvat 1954 (Mititelu & al. 1993; Chifu & al. 2014), and within this plant community was proposed a subassociation - *dalechampietosum* nomen nudum, for some forest communities within Covurlui Hills (in the forest "Adam") (Mititelu & al. 1993).

Finally, in the most recent synthesis of the wooden vegetation in Romania (Indreica, in Coldea & al. 2015) it was made a complet assimilation of the Hungarian oak stands from Tutova Hills (Eastern Romania) described by Bârcă (1973, 1984) at the Ass. *Tilio tomentosae-Quercetum dalechampii* Sârbu 1978 (Al. *Quercion frainetto* Horvat 1954), a plant community described by Sârbu (1978), without being granted a distinct syntaxonomic status of the Hungarian oak stands.

In our opinion, the the Hungarian oak stands described by Bârcă (1973, 1984) should not be subordinated to Ass. *Tilio tomentosae-Quercetum dalechampii* Sârbu 1978, a plant community widely distributed in the southern half of Moldova region (Chifu & al. 2006), which they are mainly distinguished by:

- the constant presence of *Q. frainetto* (dominant) and *Q. petraea* (subdominant or codominant) in the tree layer, as well as the presence (less constant) of some species, such as *Q. pedunculiflora*, *Q. robur*, *Q. virgilliana*, *Q. pubescens*, all of these missing within Ass. *Tilio tomentosae-Quercetum dalechampii* Sârbu 1978
- the sporadic presence of the Balkan oak (*Q. dalechampii*) in the Hungarian oak stands described by Bârcă (1973, 1984), a dominant species in the tree layer within the Ass. *Tilio tomentosae-Quercetum dalechampii* Sârbu 1978
- the Hungarian oak tree is completely missing within the phytocoenoses of Ass. *Tilio tomentosae-Quercetum dalechampii* Sârbu 1978
- nor other characteristic species for Ass. *Tilio tomentosae-Quercetum dalechampii* Sârbu 1978 are not present in "Tâmpa" or "Rădeanu" forests (e.g. *Galanthus graecus*, *Pyrus elaeagrifolia*, *Staphyllea pinnata* etc.)

We consider the phytocoenoses described in the Tutova Hills (Bârcă 1973, 1984) should be keeped within a separate plant community (of course, with a name emendations, to correspond at the nomenclature rules valid today), framed either in Al. *Aceri tatarico-Quercion* Zólyomi 1957, or in Al. *Quercion petraeae* Zólyomi & Jakucs 1957, alliances much better represented in the floristic structure (10 characteristic species for Al. *Aceri tatarico-Quercion* and 6 characteristic species for Al. *Quercion petraeae*, such as: *Pulmonaria mollis*, *Pyrus pyraster*, *Quercus pubescens*, *Quercus robur*, *Ferulago sylvatica*, etc., and *Inula hirta*, *Sedum*

telephium subsp. *maximum*, *Quercus petraea*, *Vicia cassubica*, *Genista tinctoria*, etc. respectively).

The plant communities of Hungarian oak in "Tampa"and "Rădeanu"forests differ from other forests described in Tutova Hills due to the absence of the sessile oak (*Q. petraea* sensu stricto) - a constant and codominant species within the phytocoenoses from Tutova Hills -, and other constant species within the phytocoenoses from the same Tutova Hills, in the tree layer (e.g. *Quercus robur*, *Q. virgiliana*, *Q. pubescens*, *Q. pedunculiflora*, *Sorbus aucuparia*, *Ulmus glabra*) or in herbaceous layer (*Anthemis tinctoria* subsp. *tinctoria*, *Asparagus officinalis*, *Polygonatum odoratum* subsp. *odoratum*, *Pulmonaria mollis* subsp. *mollissima*, *Rumex acetosa*) (Bârcă 1973, 1984).

It is noted the constant presence of some species that are completely missing in the phytocoenoses described in the Tutova Hills (e.g. *Asparagus tenuifolius*, *Brachypodium sylvaticum*, *Geum urbanum*, *Poa nemoralis*, *Ajuga reptans*, *Bilderdykia convolvulus*, *Carex muricata* subsp. *lamprocarpa*, *Galium aparine*, *Lapsana communis*, *Polygonatum hirtum*, *Astragalus glycyphyllos*, *Verbascum phoeniceum*, *Ornithogalum orthophylllum* subsp. *kochii*, *Symphytum ottomanum*, etc.), or they have a very sporadic presence (e.g. . *Q. dalechampii*, *Rosa canina*, *Ligustrum vulgare*, *Viola hirta*, etc.)

Also, witin the "Tampa" and "Rădeanu"forests there is a lower participation of the characteristic species for the mesophylous forests of Tutova Hills, where they are much better represented, due to the location of the respective phytocoenoses at higher altitudes (between 230 and 400 m a.s.l.), to the lower limit of the beech tree belt of vegetation (Bârcă 1973, 1984).

The Hungarian oak stands analyzed by us, also differ from the plant communities described in Chineja rivulet basin (framed in Ass. *Tilio tomentosae-Quercetum dalechampii* Sârbu 1978), both through the species that dominates the tree layer, *Quercus frainetto*, as well as by a constant presence of other species, such as *Carex muricata*, *Verbascum phoeniceum*, *Viola hirta*, *Ornithogalum orthophyllum* subsp. *kochii*, all of being absent within the Ass. *Tilio tomentosae-Quercetum dalechampii* Sârbu 1978.

The cluster analysis confirms that the plant communities described by Bârcă (1973, 1884) (**T** clusters) are clearly separated from the plant communities analyzed by us (**B** clusters), as well as by the Ass. *Tilio tomentosae-Quercetum dalechampii* Sârbu 1978 (**C** clusters) (Fig. 5).

Distribution of the Ass. Quercetum frainetto-cerris *Rudski 1949 subass.* quercetosum frainetti *subass. nov. in Romania*

The newly proposed coenotaxon is distributed in the southern part of Moldova/Eastern Romania, at the boundary between the forest-steppe zone, subzone of the xero-mesophilous oaks ("Tampa" forest, Bursucani) and the zone of the mixted forets of mesophylous oaks-beech tree (*Fagus sylvatica*) forests ("Rădeanu" forest, Căuia de Jos), so that in the floristic composition of this new cenotaxon there are many characteristic species of Cl. *Querco-Fagetea*, e.g. *Acer campestre*, *Brachypodium sylvaticum*, *Carpinus betulus*, *Dactylis glomerata* subsp. *lobata*, *Euonymus europaeus*, *Fraxinus excelsior*, *Galium schultesii*, *Geranium robertianum*, *Glechoma hirsuta*, *Malus sylvestris, Melica uniflora*, *Poa nemoralis*, *Polygonatum hirtum*, *Prunus avium*, *Stellaria holostea*, *Ulmus minor* var.

asperrima, *Ulmus minor* var. *minor*, etc.

Also, the cluster analysis (Fig. 4) shows that within this newly infracoenotaxon with *Q. frainetto*, but where *Q. cerris* is missing, from other provinces of Romania, should also be included here, as:

- **Oltenia**: the Hungarian oak stands of "Ghimpeţeanca" and "Maşu-Coşoveni" forests (Popescu 1988), the former Balş district, Olt county, under the outdated name of *Querceto farnetto* (Păun 1964)

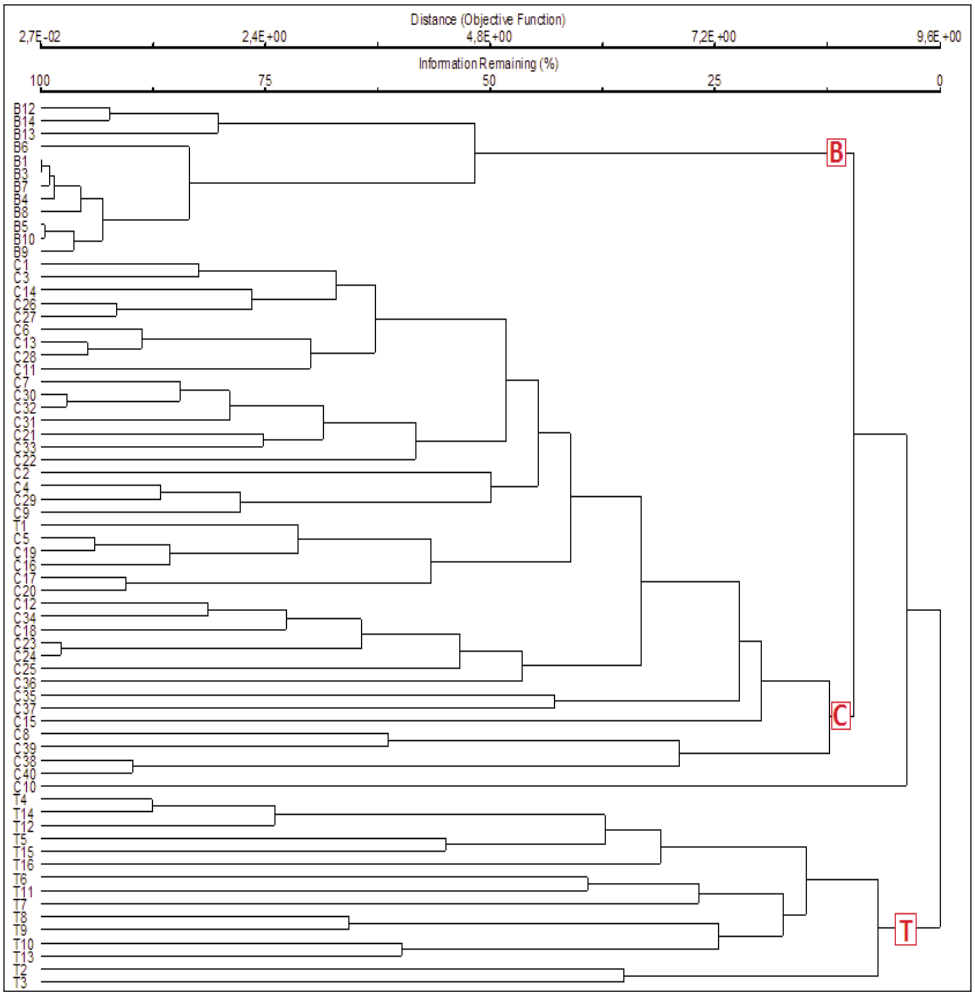

Fig. 5. Hierarchical clustering for different forest communities of Cl. *Quercetea pubescentis* in south of Moldavia: B - forests "Tâmpa", Bursucani village, Galaţi county, and forest "Rădeanu", Căuia de Jos village, Galaţi county, Ass. *Quercetum frainetto-cerris* Rudski 1949 subass. *quercetosum dalechampii* subass. nov.; C - Covurlui Hills, Ass. *Tilio tomentosae-Quercetum dalechampii*; T - Tutova Hills, Ass. *Querco frainetti-petraeae*.

- **Muntenia**: the forest "la Culme", Dejeşti, Olt county (Popescu 1988), in the forest-steppe zone between Ialomiţa and Danube rivers, under the outdated name of *Quercetum confertae* (Paşcovschi & al. 1956), within the forest-steppe island between Costeşti, Corbu, Miroşi, and Cornăţel (Paşcovschi & Doniţă 1967), in west and south Muntenia, in "Poboru" forest, Olt county (Popescu & al. 2005), other forests in north-west of Muntenia (Marcu 1962)
- **Banat**: the Danube Gorges, at Tisoviţa (Boşcaiu & al. 1971)
- **Crişana**: in Zarandului Mountains, on the hills north of Lipova, and along the middle course of Şoimuş stream - the Hungarian oak phytococenoses, framed in the Ass. *Quercetum frainetti* (Ghişa & Kovács 1963).

The individuality of the new subassociation as against the homonymous cenotaxa in the other Romania regions

Of the phytocoenoses of the newly proposed subassociation, which is characteristic for the Hujgarian oak stands of Moldavia, some species are missing against other provinces of Romania.

Thus, against to the stands with the Hungarian oak in northern Dobrogea (framed in Ass. *Carici-Quercetum frainetto* Dihoru & Doniţă 1970 and Ass. *Fragario viridis-Polyquercetum* Dihoru & Doniţă 1970), our subassociation is distinguished by the absence of the following species: *Carpinus orientalis, Fraxinus ornus, Paeonia peregrina, Carex caryophyllea, C. praecox, C. polyphylla, Oryzopsis virescens, Laser trilobum, Digitalis lanata, Ornithogalum fimbriatum, Platanthera bifolia, Arum orientale, Pyrus elaeagrifolia, Staphyllea pinnata*, etc. (Dihoru & Doniţă 1970).

In comparison with the forests of the southern Dobrogea, it differs by the lack of the next species: *Quercus cerris*, *Carpinus orientalis*, *Orchis purpurea*, *Piptatherum holciforme*, *Dioscorea communis* var. *communis*, *Physospermum cornubiense*, *Orchis simia*, etc. (Arcuş 1999).

Of the forests with the Hungarian oak of Muntenia, it differs by the absence of the next species: *Quercus pedunculiflora*, *Q. virgiliana, Carpinus orientalis, Fraxinus ornus, F. angustifolia, Pyrus elaeagrifolia, Dioscorea communis* var. *communis, Ventenata dubia, Helleborus odorus, Doronicum hungaricum, Paeonia peregrina, Ruscus aculeatus*, *Crocus flavus*, *Ornithogalum fimbriatum*, etc. (Marcu 1962; Borza 1966; Sanda & Popescu 1971; Popescu & al. 1984).

In the Hungarian oak of Oltenia, there are a number of taxa that are lacking in the similar phytocoenoses of the southern Moldavia, such as: *Comandra elegans*, *Trifolium echinatum*, *Asperula taurina* subsp. *leucanthera*, *Rosa corymbifera*, *R. gallica*, etc. (Păun 1964; Popescu 1988).

By the Hungarian oak the forests in Banat, it differs by the lack of the next taxa: *Quercus cerris, Carpinus orientalis, Sedum cepaea*, *Echinops bannaticus*, *Dioscorea communis* var. *communis*, etc. (Boşcaiu 1971; Boşcaiu & al. 1971).

As against the forests of the Zarandului Mountains, they are distinguished by the lack of the next taxa: *Juniperus communis*, *Sorbus aucuparia*, *Quercus petraea*, *Aremonia agrimonioides*, *Sedum cepaea*, *Dioscorea communis* var. *communis*, *Asplenium adianthum-nigrum*, *Melampyrum bihariense*, *Symphytum tuberosum*, *Dryopteris filix-mas*,

Peucedanum carvifolia, *Serratula* tinctoria, etc. (Pop 1978).

There are other subassociations valid described in the Romanian literature within Ass. *Quercetum frainetto-cerris* Rudski 1949, as:

- *typicum*: in Muntenia, Oltenia, Banat, and Crişana (in Indreica, in Coldea & al. 2015)
- *carpinetosum orientalis* (Knapp 44) Jov. 1955: in Danube Gorges and southern Mehedinţi Tableland (Boşcaiu & al. 1971; Roman 1974; Nanii 1975) (in Pop & Cristea 2002; Indreica, in Coldea & al. 2015)
- *tilietosum tomentosae* (Lovász 1995) Pop & Cristea 2002: in Banat (Lovász 1995) (in Pop & Cristea 2002).

Zonality

The newly proposed subassociaton is located in a transitional area, between the xerotermic forests made of white oak (*Quercus pubecens*) of forest-steppe zone of southern Moldavia on the one hand, and the mesophilous forest of *Quercus petraea* and *Q. robur* of the forestry zone on the other hand, from Tutova Hills. From the phytocenological point of view, the newly coenotaxa is framed at the interference of Cl. *Carpino-Fagetea* and *Quercetea pubescentis* (Bârcă 1984), what is similar to that of the Ass. *Tilio tomentosae-Quercetum dalechampii*, described from the Covurlui Hills (Sârbu 1978, 1979).

As the Hungarian oak is situated, in Moldavia, at its distribution limit within the general area of the species, toward north-east, consequently the stands with this species have in their floristic composition some transition species to the vegetal communities of Al. *Aceri tatarici-Quercion* and Al. *Quercion petraeae* (Indreica, in Coldea & al. 2015) or to those of Al. *Quercion pubescenti-petraeae* (Sârbu 1979).

The Hungarian oak stands (and the Turkey oak-Hungarian oak stands) in Romania belong to the Euro-Siberian region, Dacio-Illyrian province; those from the Tutova Hills belong to the Central European-East Carpathian region, the Moldavian Plateau district, and those in the Covurlui Hills belong to the Balkanik-Moesian province, the Southern Moldavia district (Borza & Boşcaiu 1965).

The Romania Hungarian oak stands into the Natura 2000 habitats

The Hungarian oak stands in Romania are assigned to the Natura 2000 habitat 91M0 Pannonian-Balkanic Turkey oak-sessile oak forests (Gafta & Mountford 2008).

In another approach (Doniţă & al. 2005, 2006), the Hungarian oak stands in Romania are assigned to the following types of natural habitats:

R4153 Danubian-Balkanik forests of *Quercus cerris* and *Q. frainetto*, with *Crocus flavus*

R4154 Danubian-Balkanik forests of *Quercus frainetto* with *Festuca heterophylla*

R4155 Danubian-Balkanik forests of *Quercus frainetto* and *Quercus cerris* with *Carex praecox*

R4156 Danubian-Balkanik oak forests of *Quercus pedunculiflora*, *Q. cerris*, *Q. frainetto*, *Q. pubescens* with *Acer tataricum*

Conclusions

-it is considered that Hungarian oak had a continuous and much larger distribution area in the past than it is today
- both species distribution in Romania and the existence of pure Hungarian oak stands in the mesophilous broadleaved forests, are mainly due to the human activities, nowadays
- in Moldavia, the Hungarian oak is a rather rare species, building self-standing stands in some places only
- if there is admitted the existence of a single coenotaxon, i.e. *Quercetum frainetto-cerris*, which groups the Hungarian oak and Turkey oak in Romania's vegetation, then it is necessary to define some infracoenotaxa (as subassciations, variants, facieses) to highlight the regional features of the primary association
- within the Ass. *Quercetum frainetto-cerris* have been validly described until now as the following infracenotaxa in Romanian literature: subass. *typicum* in Muntenia, Oltenia, Banat, and Crişana; subass. *carpinetosum orientalis* in the Danube Gorges and south of the Mehedinţi Tableland; subass. *tilietosum tomentosae* in Banat
- the Hungarian oak stands from the eastern of Romania (Moldova) were included in a new infracenotaxon, namely subass. *quercetosum dalechampii* subass. nov.
- other regions in which this subass. (*quercetosum dalechampii*) is located are: north-west and south of Muntenia, Oltenia, Banat, and Zarandului Mountains
- from the zonality point of view, the newly proposed subassociation lies in the transitional space between the xerothermal forests made up of *Quercus pubecens*, from the forest-steppe zone of southern Moldova, on the one hand and the mesophylous forests of *Quercus petraea* and *Q. robur* of the forestry zone on the other hand, from the Tutova Hills
- from the phytocenological point of view, the newly proposed subassociation it is situated at the interference of the Cl. *Carpino-Fagetea* and Cl. *Quercetea pubescentis*, a similarly situation to that of Ass. *Tilio tomentosae-Quercetum dalechampii*, from the Covurlui Hills

This study is compliant with the ethical standards of research.

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