

## ORNO-COTINO-QUERCETUM PUBESCENTIS ASS. NOVA PROV. ON THE SLOPES OF TITEL HILL (SERBIA)

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**Abstract** — Studied by many botanists from the floristic and vegetation-geographical aspects over the last hundred years, the herbaceous plant cover in dominant on Titel Hill. The first data on plant communities were registered in 1983, when a significant contribution to the study of vegetation of steppe character was made. At that time, presence of shrubby remnants of forest vegetation on Titel Hill was registered. Since 1983, fragments of typical xerothermic woods of pubescent oak have been registered.

**Key words:** Forest vegetation, steppe vegetation, xerothermic elements

UDC 630\*1(497.11):574

### INTRODUCTION

Titel Hill is a loess "island" that rises above the plains of SE Bačka Province in Northern Serbia (UTM 34TDR31/40) (B u k u r o v, 1971). Its vegetation originally had all climozonal characteristics of the mosaic-complex of forest-steppe communities represented by the alliances *Aceri tatarico-Quercion* Zolyomi et Jakucs, 1957 and *Festucion rupicola* Soó, 1940 (P a r a b u ć s k i and J a n k o v i ć, 1978). Due to centuries-old influence of a man, the forests on Titel Hill have almost disappeared, while the steppe is disappearing as well. The latest research indicates that xerothermic forests are present in fragments, on inaccessible terrains of the hill on the side by the Tisa river. In our opinion, the mentioned fragments are representative enough to make judgements about the appearance and structure of the former forest on the hill.

### MATERIAL AND METHODS

Floristic and phytocenological surveys of forest vegetation on the northeastern slopes of Titel Hill were conducted over several growing seasons. Determination of recorded plant species was done ac-

ording to Flora SR Srbije (J o s i f o v i ć, 1970-1977; S a r i ć, 1986, 1992) and Flora Europaea (T u t i n et al., 1968-1980, 1993). Life forms for each recorded species and their affiliation to different distribution types are given according to R a u n k i e r (1934) and G a j i ć (1980), respectively. The phytocenological survey and analyses of the obtained gained data were done according to B r a u n – B l a n q u e t (1964). Syntaxonomical affiliation is given according to S o ó (1964-1980).

### RESULTS AND DISCUSSION

#### *I. Extent of the community*

About 3 km downstream from the settlement of Mošorin (UTM 34T DR 31), from the side of the hill at the level of the river island to the Titel Brick Plant (UTM 34T DR 31/40), forest vegetation extends within a zone 100 m wide and 2-3 km long. It covers the steep inaccessible northeastern slopes, edges of clefts, and recesses. The vegetation includes elements of xerophilic and thermophilic forests, as well as some intermediate elements. This is a consequence of accumulation of atmospheric sediments on the terraced geomorphologic forms and the action of

water, which deepens the existing trenches and ravines, denuding the geological substratum. Water of the Tisa River has negative influence on the extent of forest stands. It permanently erodes the hill, creating new rockslide. At the same time, evaporation from the Tisa makes the macroclimate milder.

## II. Structure and floristic components of the community

The phytocenological table (Table 1) shows the relative floristic abundance of these forest fragments. Seventy-three species were registered.

*Fraxinus ornus* and *Cotinus coggygria* are dominant in the stratum of short trees and bushes. They "impose" themselves as edificators of the forest vegetation on the slopes of this plateau by their constant presence and quantity. Stojanović (1983) registered their presence in thermophilic shrubbery, but with a low degree of presence and in small numbers with limited covering.

Being characteristic species of the order *Quercetalia pubescentis* and elements of sub-Mediterranean character, they point to the xerothermic character of the stands, while *Cotinus coggygria* is also important as a Tertiary relic (Gajić, 1984).

A special characteristic of the analyzed forest stands is the presence of *Quercus pubescens*, which is here registered in the flora and vegetation of Titel Hill for the first time. This oak is very rare in the mentioned area, but its presence is of great importance because it is a species which is an edificator of xerothermic forests in the sub-Mediterranean region (Janjović, 1984). About 10 trees of this species were registered, 10-15 m high and up to 25 cm in trunk diameter, which indicates that they are part of a young forest. In areas of cleared forests, spreading of the pioneer species *Fraxinus ornus* has been favored. In keeping with the existing ecological conditions, forest litter is either missing (ravines and trenches) or is 3 cm thick, indicating "young" forest. On shallow terrain subject to erosion, survival of the registered stands is endangered, especially due to the negative activities of man. Thus, the natural elements which to some extent bound loose soil have been disappearing. Although the absence of oak sprouts

is upsetting, sprouts of ash and bushy species have been found. In this successive stage of degradation, *Fraxinus ornus* and *Cotinus coggygria* increase in number and give a wrong impression about the potential of the habitat. Their sprouting prevents natural regeneration of oak forests, but apart from the negative role this has a positive one too because by growing on steep slopes such sprouts create zones of protection which are an important antierosive factor.

In addition to the above-mentioned species, the following are characteristic of the community: *Ligustrum vulgare*, *Viburnum lantana*, *Evonymus verrucosa*, *Lonicera xylosteum*, *Campanula pericifolia*, etc. Most of them are characteristic species of the order *Quercetalia pubescentis*, while the first two are species of the alliance *Berberidion* as well. The characteristic species of this alliance - *Berberis vulgaris* - is found only in marginal stands of forests and short bushes. Stojanović (1983) indicates the species *Cotinus coggygria* as representative of the alliance *Berberidion*. This author also states that a species differentiating the given alliance is *Ligustrum vulgare*. Species which are constantly or significantly present in the forest stands underline the specific conditions of Titel Hill and include the most characteristic xeromorphic shrubs of the southern region of Central Europe (the alliance *Berberidion* of the order *Prunetalia*). The elements of forest-steppe vegetation of the alliances *Aceri tatarico-Quercion* and *Festucion rupicolae* point to the thermophilic character of the stands, especially the marginal ones. Some species simultaneously characterize both forest vegetation of the order *Quercetalia pubescentis* and steppe vegetation of the alliance *Festucion rupicolae*, order *Festucetalia valesiacae* and class *Festuco-Brometea* (species in Table 1 marked with 0). Attention should be paid to the following representatives of the analyzed stands: *Peucedanum alsaticum*, *Vinca herbacea*, *Asparagus officinalis*, and *Silene italica*. Together with the forest elements *Acer tataricum* and *Campanula rapunculoides*, they represent species different from the remnants of forest vegetation registered as shrubbery by Stojanović (1983). The abundance of characteristic species of the *Quercetalia* order and alliances *Quercion frainetto*, *Berberidion*, and *Aceri tatarico-Quercion* tells us something about the original climozonal forests.

**Table 1.** Phytocenological table of ass. *Orno-Cotino-Quercetum pubescentis* ass. nova prov.

Remnants of forest vegetation on the Titel hill		Ass. <i>Orno-Cotino-Quercetum pubescentis</i> ass. nova prov.											
		<i>asplenietosum</i> subass. nova					<i>aceretosum tatrici</i> subass. nova						
Floral elements	Life form		1	2	3	4	5	6	7	8	9	10	D
		<b>Association character species</b>											
		Stratum of trees and bushes											
Subm.	MM	<i>Fraxinus ornus</i> L.	3.1	4.1	3.1	3.1	3.1	3.1	3.1	3.1	4.1	4.1	V
Pont.-ca.-subm.	M	<i>Cotinus coggygia</i> Scop.	2.1	+	2.1	2.1	2.1	2.1	2.1	+	3.1	2.1	V
Subse.	M	<i>Ligustrum vulgare</i> L.	2.1	+	+	2.1	3.2	1.2	3.1	2.2	-	+	V
Subpont.	M	<i>Euonymus verrucosa</i> Scop.	+	-	-	+	2.1	2.1	+	-	+	-	III
Subm.	M	<i>Viburnum lantana</i> L.	+	2.1	-	3.2	-	+	-	2.1	-	2.1	III
Evr.	M	<i>Lonicera xylosteum</i> L.	-	-	2.1	-	+	+	-	2.2	+	-	III
Subm.	MM-M	<i>Quercus pubescens</i> Willd.	3.1	-	-	-	+	2.1	-	-	-	-	II
		Stratum of ground flora											
Subse.	H	<i>Galium album</i> Mill.	3.2	3.4	+	3.2	3.2	2.3	+	2.2	2.2	2.2	V
Evr.	H	<i>Campanula persicifolia</i> L.	1.2	1.2	-	+	2.2	+	1.2	-	-	1.2	IV
		<b>Diferential species</b>											
		Stratum of trees and bushes											
Subbalc.	MM-M	<i>Tilia tomentosa</i> Moench	+	-	-	-	-	-	-	-	-	-	I
Subatl.-Subm.	E-M	<i>Hedera helix</i> L.	+	1.1	1.1	-	-	-	-	-	-	-	II
		Stratum of ground flora											
Cosm.	Ch	<i>Asplenium trichomanes</i> L.	1.2	+	+	1.2	1.2	-	-	-	-	-	III
Evr	Ch	<i>Asplenium adianthum-nigrum</i> L.	+	-	-	1.2	-	-	-	-	-	-	I
Circ.	Ch	<i>Cystopteris fragilis</i> (L.) Bernh.	1.2	-	1.2	2.2	2.2	-	-	-	-	-	II
Subevr.	TH	<i>Campanula rapunculus</i> L.	+	-	-	1.1	-	-	-	-	-	-	I
		Stratum of trees and bushes											
Pont.-pan.	M	<i>Acer tataricum</i> L.	-	-	-	-	-	2.1	3.1	+	2.1	+	III
Subpont.ca.	M	<i>Rhamnus catharticus</i> L.	-	-	-	-	-	1.1	+	2.1	2.1	-	II
Subse.	M	<i>Berberis vulgaris</i> L.	-	-	-	-	-	+	-	-	-	+	I
		Stratum of ground flora											
Subpont.ca.	H	o <i>Peucedanum alsaticum</i> L.	-	-	-	-	-	1.1	1.1	-	2.1	-	III
Subpont.	G	o <i>Asparagus officinalis</i> L.	-	-	-	-	-	+	-	-	+	-	I
		<b>Quercetalia pubescentis Br.-Bl. 1931</b>											
		Stratum of trees and bushes											
Pont.	N	o ^ <i>Chamaecytisus austriacus</i> (L.) Link.	+	-	-	-	2.1	2.1	3.1	2.1	3.1	3.1	IV
		Stratum of ground flora											
Evr.	H(G)	<i>Sedum telephium</i> L. subsp. <i>maximum</i> (L.) Krockner	1.1	+	1.1	1.1	+	1.2	2.2	1.2	2.2	2.1	V
Subpont.-subm.	Ch	o ^ <i>Teucrium chamaedrys</i> L.	+	+	-	2.2	-	1.2	+	2.1	1.2	-	IV
Circ.	H	<i>Calamintha vulgaris</i> (L.) Druce	+	2.1	2.1	2.1	+	-	-	-	-	-	III
Subsudsib.	H	o ^ <i>Campanula bononiensis</i> L.	+	-	-	-	-	-	+	1.1	-	-	II
Pont.-pan.	H	o ^ <i>Vinca herbacea</i> W. et K.	-	-	-	-	-	+	-	-	-	1.1	I
Pont.-ca.	H	o ^ <i>Cynanchum vincetoxicum</i> (L.) Pers.	-	-	-	-	-	-	+	-	-	+	I
Subpont.	H	o ^ <i>Coronilla varia</i> L.	-	-	-	-	-	-	1.1	-	1.1	-	I
		<b>Querco-Fagetea Br.-Bl. et Vlieger 1937</b>											
		Stratum of trees and bushes											
Subatl.-subm.	MM-M	<i>Ulmus carpiniifolia</i> Gled.	+	2.1	-	-	-	1.1	+	2.1	2.1	2.1	IV
Subse.	M	<i>Rosa canina</i> L.	+	2.1	2.1	-	2.2	+	2.1	2.1	2.2	+	V
Subse.	M	<i>Cornus sanguinea</i> L.	-	-	2.1	-	3.2	1.1	+	2.1	2.1	+	IV
Subse.	M	<i>Euonymus europaeus</i> L.	+	-	2.1	-	-	+	2.1	2.1	+	+	IV
Subsudsib.	H(N)	<i>Rubus caesius</i> L.	+	-	-	+	+	+	-	1.1	2.3	2.2	IV
Subpont.	M	o ^ <i>Prunus spinosa</i> L.	-	-	-	-	-	2.1	1.1	2.1	2.1	2.1	III
Subse.	M	<i>Crataegus monogyna</i> Jacq.	-	-	-	-	-	1.1	-	2.1	2.1	+	II

Table 1. Ctd.

Subatl.-subm.	N-E	<i>Clematis vitalba</i> L.	1.1	-	2.4	1.2	+	-	-	-	-	-	II
		Stratum of ground flora											
Circ.	TH ^	<i>Turritis glabra</i> L.	2.1	+	2.1	2.1	+	1.1	2.1	+	1.1	1.1	V
Se.	H ø ^	<i>Silene italica</i> (L.) Pers.	1.2	2.2	+	1.2	1.2	1.2	1.2	-	-	+	IV
Subsudsib.	H	<i>Brachypodium silvaticum</i> (Huds)P.B.	2.3	2.2	2.2	2.2	2.2	2.3	-	-	-	2.2	IV
Se.	H	<i>Carex pairei</i> F. Schultz.	2.2	2.3	-	2.2	2.2	2.3	1.1	-	+	-	IV
Subse.	H-Ch ^	<i>Veronica chamaedrys</i> L.	+	-	1.1	-	-	2.2	-	+	2.2	2.2	III
Subpo.-subpan.	G	<i>Polygonatum latifolium</i> (Jacq.) Desf.	1.2	-	-	-	-	-	-	2.2	-	-	I
Subcirc.	Th	<i>Geranium robertianum</i> L.	1.2	1.2	2.2	+	2.2	-	-	-	-	-	II
Subse.	H	<i>Ficaria verna</i> Huds.	2.2	-	2.1	3.1	+	-	-	-	-	-	II
Pont.-eastsubm.	H(ChG)	<i>Glechoma hirsuta</i> W. et K.	1.1	-	+	+	1.1	-	-	-	-	-	II
Subatl.-subme.	H	<i>Viola odorata</i> L.	+	-	2.2	1.2	-	-	-	-	-	-	II
Evr.	Th	<i>Galium aparine</i> L.	1.2	+	-	-	+	-	-	-	-	-	II
Evr.	H	<i>Chelidonium maius</i> L.	-	-	2.1	-	-	-	-	-	-	-	I
Evr.	Th	<i>Geranium rotundifolium</i> L.	+	-	-	-	-	-	-	-	-	-	I
<b>Adjunct species</b>													
<b>Festucion rupicolae Soó (1940) 1964;</b>													
<b>Festucetalia valesiaca Br.-Bl. et Tx. 1943</b>													
<b>Festuco-Brometea Br.-Bl. et Tx. 1943</b>													
Stratum of ground flora													
Subpont.	H	<i>Campanula sibirica</i> L.	1.2	1.2	1.2	1.2	1.2	1.1	+	-	1.2	+	V
Evr.	H	<i>Festuca valesiaca</i> Sch. subsp. <i>pseudovina</i> (Hack) A. Gr.	1.2	2.2	-	1.2	1.2	2.3	2.3	+	-	2.2	IV
Pont.-pan.	H	<i>Viola ambigua</i> W. et K.	1.2	-	-	+	+	2.2	1.1	+	2.2	-	IV
Circ.	H	<i>Koeleria gracilis</i> Pers.	1.1	-	-	-	1.2	1.2	2.2	1.2	+	-	III
Subpont.	Th(H-Th)	<i>Cerinth minor</i> L.	+	-	1.1	-	+	+	-	1.1	-	-	III
Subpo.-subpan.	TH-H ^	<i>Erysimum diffusum</i> Ehrh.	+	-	-	-	-	+	-	-	1.2	1.2	II
Pont.-ca.	H	<i>Hyosotis elegans</i> Steph. ex Willd.	2.2	+	-	2.2	2.2	-	-	-	-	-	II
Subevr.	TH ^	<i>Myosotis arvensis</i> (L.) Hill.	1.2	+	1.1	-	-	-	-	-	-	-	II
Subse.	Th ^	<i>Thlaspi perfoliatum</i> L.	1.1	+	-	-	1.1	-	-	-	-	-	II
Pont.-subm.	G ^	<i>Allium rotundum</i> L. subsp. <i>waldsteinii</i> (G.Don) Soó	+	-	-	-	-	-	-	-	-	-	I
Subm.	Th	<i>Lathyrus sphaericus</i> Retz.	+	-	-	-	-	-	-	-	-	-	I
Evr.	G	<i>Orobanche alba</i> Steph.	-	-	-	-	-	+	-	-	-	-	I
Subm.	G	<i>Leopoldia comosa</i> (L.) Parl.	-	-	-	-	-	+	-	-	-	-	I
<b>Other species</b>													
Stratum of trees and bushes													
Adv.	MM	<i>Robinia pseudacacia</i> L.											
Adv.	MM	<i>Celtis occidentalis</i> L.											
Adv.	MM	<i>Morus nigra</i> L.											
Stratum of ground flora													
Subpont.	H	<i>Bryonia alba</i> L.	1.1	+	+	1.	1.1	1.1	1.1	1.1	+	2.1	V
Subevr.	H	<i>Poa trivialis</i> L.	1.1	+	-	+	1.2	1.2	2.3	2.2	21.3	2.2	V
Subpont.	Th	<i>Anthriscus cerefolium</i> (L.) Hoffm.	2.1	+	-	2.12	2.2	1.3	3.2	3.1	+	-	IV
Subevr.	Th	<i>Bromus sterilis</i> L.	1.1	-	1.2	-	-	1.2	+	1.2	-	+	III
Subevr.	Th	<i>Bilderdykia convolvulus</i> (L.) Dum.	-	2.2	-	-	2.2	1.2	+	-	-	-	II
Subse.	Th	<i>Veronica hederifolia</i> L.	1.1	1.1	+	1.1	1.1	-	-	-	-	-	II
Subpont.	H(Ch)	<i>Ballota nigra</i> L.	+	-	-	-	-	-	-	-	-	-	I
Subpont.-subm.	Th-TH	<i>Vicia villosa</i> Roth.	-	-	-	-	-	-	-	-	-	+	I

## LEGEND:

ø - *Festuco-Brometea* Br.-Bl. et Tx 1943 and *Quercetalia pubescentis* BR.-Bl. 1931 elements

^ - Transgressive species

D - Degree of presence

According to statements of Parabućki and Janković (1978) and Jovanović (1986), the natural vegetation of the loess plateaus of Vojvodina consists of mosaically spread communities of the alliances *Aceri tatarico-Quercion* and *Festucion rupicola*, i.e., forest-steppe vegetation, which is in accordance with the opinion of Soó (1940). For this reason, the presence of steppe species is not surprising in these forest stands. Those which occur most frequently are: *Galium album*, *Campanula sibirica*, *Festuca valesiaca* subsp. *diffusum*, *Hypericum elegans*, *Allium rotundum* subsp. *waldsteinii*, and others. In the stratum of herbaceous plants, *Sedum telephium* subsp. *maximum* is most constantly present among representatives of the order *Quercetalia pubescentis*, while *Teucrium chamaedrys*, *Calamintha vulgaris*, *Campanula bononiensis* and others are less frequent and fewer in number.

Of species of the class *Quercio-Fagetea* in the stratum of trees, *Ulmus carpinifolia* can be singled out as a species of sub-Atlantic-sub-Mediterranean character. *Cornus sanguinea* and *Evonymus europaeus* are registered among short trees and bushes with the same degree of presence (IV), while *Rosa canina* has a greater degree of presence (V). The above-mentioned species belong to the category of sub-Central-European floristic elements and are of a mesophilic character. The same is true of *Clematis vitalba*, *Crataegus monogyna*, and other common forms of shrubbery.

In the herbaceous stratum, species of the class *Quercio-Fagetea* which distinguish the newly recorded community include the following: *Turritis glabra*, *Silene italica*, *Veronica chamaedrys*, *Geranium robertianum*, *Viola odorata*, *Geranium rotundifolium* and *Polygonatum latifolium*. They belong to the category of widespread floristic elements. The same applies to two other significantly present species, *Brachypodium sylvaticum* and *Carex pairei*, which are also present in shrubby vegetation. Among other species, only the species *Robinia pseudoacacia*, *Morus nigra*, and *Celtis occidentalis* are registered here and there. Their presence and spreading are the result of anthropogenic influence. In this less important group of plants, there are species different from typical shrubbery, for example *Poa trivialis*, *Anthriscus cerefolium*, *Bromus sterilis* and *Bilderdykia convolvulus*. Having the same

characteristics, the fern *Cystopteris fragilis*, together with some seed plants and two species of the fern genus *Asplenium* (*A. adiantum-nigrum* and *A. trichomanes*) are mesophyllic representatives of the analyzed forest.

Taking into consideration what has been said above and the fact that we are dealing with a stage of degradation of pubescent oak forests with dominance flowering ash and young fustic as secondary phenomena, we consider the provisory naming of the community *Orno-Cotino-Quercetum pubescentis* ass. nova justified. This tripartite name indicates present characteristics of the analyzed forests with all specific features, although it is not in accordance with article 10 and recommendations of the "Codex of the International Phytocoenological Nomenclature" (Barkman et al., 1976). The name itself points out both the relic nature and the polydominant character of the community. By indicating the species *Fraxinus ornus* and *Cotinus coggygria* in the name of the community, we automatically differentiate the stands on Titel Hill from the associations *Cotino-Quercetum pubescentis* and *Orno-Quercetum pubescentis*, which are registered in Hungary within the separate alliance *Orno-Cotinion* Soó 1960 (Soó, 1964-1985); from the community *Orno-Quercetum pubescentis* Gajić, 1956, an oak area in the hilly region of Serbia (Mišić, 1984); and from the association *Orno-Quercetum petraea-pubescentis* Janković, 1980 on the slopes of Mt. Fruška Gora (Janković et Mišić, 1980).

Strata of the community are clearly present. Ash and oak dominate in the highest stratum (up to 15 m high). Depending on the degree of degradation the stratum of short trees and bushes has a covering value of 20-70%. By way of contrast, the ground stratum is very rich and mainly dense.

### III. Synecology and separation of the community

The analyzed forest stands are developed on inaccessible steep slopes with northeastern exposure and 50-70° inclination, as well as on terraces. The floristic structure and ecology of these stands are strongly influenced by the carbonate composition of the soil, the loess geological base, and the presence of numerous trenches and ravines through which at-

mospheric water carries away the shallow pedological cover.

Exposure of the slopes to wind from the south-east (košava) gives the climate pronounced continental characteristics. In addition to the presence of continental Pontic steppe species in the forest stands of Titel Hill, there are numerous sub-Mediterranean species owing to mesoclimatic insolation of the upper parts of the slopes and open area of the marginal forest stands. A specific one is *Quercus pubescens*, the most xeromorphic and thermophilic of deciduous oaks which (like *Cotinus coggygria* and *Berberis vulgaris*) is a Tertiary relic. In the post-glacial period, these species found refuge in the woods of Titel Hill, especially in the sheltered valleys, replacing the steppe ["steppe-tundra" according to Janković (1984) which covered the mountain ranges and forward positions exposed to eastern and northern winds. The site's specific synecological conditions are a consequence of proximity to the Tisa river, which creates a mild meso- and microclimate on recesses and terraces closer to the hill itself.

The community *Orno-Cotino-Quercetum pubescentis* grows on soil of the chernozem type (eroded, carbonate-free and brownized, calcareous). According to Živković et al. (1972), formation of these variants of chernozem is a direct consequence of the existence of forest vegetation. On the other hand, the ecology specific for xerothermic oak woods is somewhat altered due both to nearness of the Tisa and erosion processes under conditions of the varied and "plastic" geomorphology of the terrain.

A) The central stands, which are physiognomically more typical, are characterized by higher presence of *Quercus pubescens* (a sub-Mediterranean species) and the climbers *Hedera helix* and *Clematis vitalba*. These two sub-Atlantic-sub-Mediterranean elements indicate that we are dealing with modified thermophilic stands. The sub-Atlantic species *Tilia tomentosa* and dense herbaceous stratum with numerous elements of sub-Central-European and Central European characters confirm their mesomorphic nature. The same property is characteristic of the ferns *Asplenium trichomanes* (with cosmopolitan distribution) and *Cystopteris fragilis* (a circumpolar species),

which are present in almost all stands. A fern with Eurasian distribution, *Asplenium adiantum-nigrum* (a characteristic species of the order *Quercetalia pubescentis*), is present in some of the stands. The high constancy, number, and covering value of these ferns are dictated by more temperate climatic conditions in the valleys (lower insolation, more shading, and higher relative atmospheric humidity) due to dense treetops, periodical accumulation of water in the habitat, and nearness of the Tisa.

They are recorded as subassociation *Asplenietosum* subass. nova for the above-mentioned reasons and because the presence of ferns reflects the synecology of these stands and makes them recognizable. The specific ones present include *Campanula rapunculus*, *Calamintha vulgaris*, *Viola odorata*, *Geranium robertianum*, *G. rotundifolium*, etc. Significant among the adjunct species are *Hypericum elegans*, *Allium rotundum* subsp. *waldsteinii*, and *Lathyrus sphaericus*, which are typical steppe plants (alliance *Festucion rupicola*). Together with species of the alliance *Aceri tatarici-Quercion*, they are indicators of the climozonal vegetation of Titel Hill, which at the same time may occur elsewhere on loess plateaus of the Pannonian Plain.

*Quercus pubescens*, *Tilia tomentosa*, *Hedera helix*, *Campanula rapunculus*, the ferns present, both species of the genus *Geranium*, *Viola odorata*, *Lathyrus sphaericus*, and *Hypericum elegans* - which belong only to the stands of subass. *Asplenietosum* - are also important as species distinguishing the given vegetation from the shrubby vegetation registered by Stojanović (1983). The addition of species characteristic of the community as a whole makes it clear that we are dealing with a specific type of vegetation.

B) The floristically poor stands of the second subassociation (50 species, 57 species) are named *Aceretosum tatarici* subass. nova. The name itself indicates that the given vegetation is a subassociation of an oak community distinguished by the presence of *Acer tataricum*. In contrast to the previous subassociation, this one is recognizable by a more developed stratum of bushes with typical xerothermic representatives. Its stands are linked with forward

positions, crests of the plateau, the tops of slopes, and marginal positions exposed to winds and insolation. The stands have a more xerothermic character and grow under conditions of higher evaporation and lower humidity. Due to this fact, their structure is characterized by species with a pronounced continental type of distribution i.e., sub-Pontic-Central Asian floristic elements like *Rhamnus catharticus* and *Peucedanum alsaticum*; the sub-Pontic plants *Asparagus officinalis* and *Coronilla varia*; and the Pontic species - *Chamaecytisus austriacus*.

*Acer tataricum*, *Rhamnus catharticus*, *Berberis vulgaris*, *Peucedanum alsaticum*, and *Asparagus officinalis* give these stands their basic identity. The species *Berberis vulgaris* is one of the most xeromorphic shrubs of the Pannonian Plain. These five characteristic species of subassociation *Aceretosum* are not recorded for the shrubbery on Titel Hill (Stojanović, 1983). *Vinca herbacea* and *Cynanchum vincetoxicum*, which are characteristic of the order *Quercetalia pubescentis*, are also distinguishing features. Among the species of this order, an important one is the bushy plant *Chamaecytisus austriacus*, which is observed in both subassociations, but with greater quantitative presence in the more xerothermic one. It is an indicator of the degree of degradation of the original forest stands because it (together with *Fraxinus ornus*) occurs in habitats of cleared oak forests. At the same time, it is in contact with the steppe stands that are typical of the gentle slopes of this plateau. Besides the species registered as distinctive of the whole community, there are also species which distinguish subass. *Aceretosum tatarici* from other shrubby vegetation. They are: *Veronica chamaedrys*, *Viola ambigua*, *Koeleria gracilis*, *Erysimum diffusum*, and *Orobancha alba*.

In the syngenetic sense, the stands of subassociation *Aceretosum tatarici* are a continuation of the alliance *Prunicon fruticosae* and then of the steppe alliance *Festucion rupicolae*. Connection with the steppe vegetation that dominates on Titel Hill (Butorać

and Igić, 1995) is even possible by regressive succession through a bushy stage with *Chamaecytisus austriacus*.

In the absence of man, progradation towards the original oak forest is possible as a result of reduced presence of populations the species *Fraxinus ornus* and *Cotinus coggygria* in structure of this community. However, subass. *Aceretosum tatarici* would still be represented and defined by some continental and xerothermic species which are the usual elements of this type of vegetation owing to the specific ecology of vegetation in forward and sunny geomorphological positions of Titel Hill high above the bed of the Tisa.

#### IV. Biological spectrum of the community

The community *Orno-Cotino-Quercetum pubescentis* consists of 73 species, one third of which are hemicryptophytes (Table 2). Their dominance is characteristic of steppe phytocenoses of the southern edge of the Pannonian Plain. According to Diklić (1984), they have a dominant "role" in both the forests and shrubby vegetation of Serbia. Almost identical presence is shown by the group of phanerophytic woody forms. The significant contribution of therophytes indicates the xerothermic character of the original forest-steppe community. The observed presence of geophytes and chamaephytes indicates the existence of pronounced climatic extremes. Hemitherophytes, chamaephytes, and nanophanerophytes are present in smaller numbers.

The biological spectrum of the association shows evident differences in the participation of various life forms (Table 2), and confirms the justification of separation of subassociations.

Within the subassociation *Asplenietosum*, the presence of hemicryptophytes, hemitherophytes, and nanophanerophytes is in accordance with general characteristics of the community. There is a significant difference between subassociations with re-

**Table 2.** Biological spectrum of ass. *Orno-Cotino-Quercetum pubescentis*

life forms	H	Ph	Th	Ch	TH	G	N
%	38.5	22.75	17.5	7	7	3.5	3.5

spect to phanerophytes. At first glance, it is not logical that marginal stands, which are closer shrubby vegetation, have more phanerophytes (38%) than the central, forest type (22.75%). This is due to the strong participation of microphanerophytes in stands of the marginal subassociation *Aceretosum tatarici*. This subassociation contains steppe geophytes that are less present in the subassociation *Asplenietosum*. The last-mentioned subassociation contains more therophytes. Chamaephytes are more present in the subassociation *Asplenietosum* due to locally expressed bad conditions.

#### V. Spectrum of distribution types

An idea of the habitats, florogenesis, and vegetation is obtained from the relations of floristic elements in forest stands on Titel Hill (Table 3). Most conspicuous is the Pontic-Central Asian group (32.64%). There are no real Pannonian elements, but only Pontic-Pannonian and sub-Pontic-sub-Pannonian ones. This is related to the origin of the vegetation somewhere in the East, in the Pontic steppe. The significant occurrence of Eurasian elements indicates the presence of continental influence, while species of the Central European group indicate more humid conditions here and there. Widely distributed plants, including cultivated plants which became wild, and neophytes account for 12.24%. Only one species (*Tilia tomentosa*) derives from the florogenetic region of the Balkans. It should be mentioned that this species finds conditions for its survival in places where oaks are cut because, being a heliophyte, it prefers open areas.

The specific floristic structure of the analyzed forests is characterized by the low presence of sub-Atlantic-sub-Mediterranean elements, as "witnesses" to the influence of warm and humid geological periods on florogenesis. In contrast to them, plants of the sub-Mediterranean group prefer xerothermic forest habitats.

A survey of the spectrum of distribution types (Table 3) shows that central European, sub-Mediterranean, and other floristic elements are present in the same percentages in both subassociations. This is related to mesophilic and thermophilic char-

acteristics of this phytocenosis.

In comparison with the subass. *Aceretosum tatarici*, the subassociation *Asplenietosum* has more elements of the Euroasian and sub-Atlantic groups of floristic elements. They also differ with the respect to one Balkan species.

#### VI. Comparison with shrubby vegetation registered by Stojanović (1981) 1983

In analysis of the vegetation of Titel Hill Stojanović (1983) recorded shrubbery as remnants of forest vegetation without defining the community. The phytocenological table that she presented includes the alliance *Aceri tatarico-Quercion*, whose existence is given in the conclusion as an assumption. However, it is obvious from the table that this shrubbery represents the last stage in the degradation of xerothermic oak forests. Elements of the order *Prunetalia* and its alliances (*Prunion spinosae* and *Prunion fruticosae*) are dominant there. In describing this shrubbery, Stojanović (1983) emphasized that it is vegetation of the alliance *Prunion fruticosae*, which is debatable.

Comparison of the newly described forest stands of Titel Hill with previously described shrubby vegetation, reveals certain similarities, but differences as well. Similarities are as follows: the stands are xerothermic; they can be found in loess of the forest-steppe zone; they include species of the alliances *Aceri tatarico-Quercion*, *Berberidion*, and *Prunion fruticosae*; and they have common species in the stratum of bushes and steppe elements among the adjunct species. Species like *Fraxinus ornus*, *Cotinus coggygria*, *Cornus sanguinea*, *Rosa canina*, *Ligustrum vulgare*, *Chamaecytisus austriacus*, etc., are present in the newly separated forest community.

Stands referred to as the association *Orno-Cotino-Quercetum pubescentis* have forest features. In spite of the noticeable presence of short trees and bushes and a very bushy herbaceous stratum, the main features are given by *Quercus pubescens*, *Fraxinus ornus*, *Ulmus carpinifolia*, *Tilia tomentosa*, and other woody plants. The more mesophilic variant of the phytocenosis is characterized featured by the presence of some vines and ferns in the herbaceous stratum, while the



**Table 3:** Spectrum of distribution types of ass. *Orno-Cotino-Quercetum pubescentis*

Distribution types	Pont.-C. As.	Euras.	S. Eur.	Sub-Atl.	Sub-Med.	Balk.	Other
%	32.64	23.12	18.4	5.44	6.8	1.36	12.24

following forest-steppe elements of Pontic-Central Asian and Pontic-Pannonian character are specific for the more xerothermic subassociation: *Acer tataricum*, *Rhamnus catarticus*, *Vinca herbacea*, *Asparagus officinalis*, etc. Real steppe elements are more extensively present in the herbaceous stratum of shrubbery.

Forest stands are registered on the northeastern slopes only, while shrubbery can be found throughout the whole area and on all exposures of Titel Hill. Differences are also evident in the great number of distinctive species (45). There are only 28 common species, pointing to a very low coefficient of similarity. Preserved forest fragments are floristically poorer (with 73 species vs. 96 in shrubbery). This is a feature of forest vegetation because the dense structure of the tallest stratum makes survival of some plant species in the lower strata impossible.

Thus, the briefly discussed similarities and differences already indicate the specific character and unique structure of the registered forest stands on Titel Hill.

*Acknowledgments* - This paper is a result of investigations done under the aegis of a project (No. 143037) supported by the Ministry of Science, Republic of Serbia.

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**ORNO-COTINO-QUERCETUM PUBESCENTIS ASS. NOVA PROV.  
НА ПАДИНАМА ТИТЕЛСКОГ БРЕГА (СРБИЈА)**

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Зељаста биљни покривач, који је био изучаван са флористичког и вегетацијско-географског аспекта, од стране многих ботаничара током протеклих сто година, доминира на Тителском брегу. Први подаци о биљним заједницама Тителског брега датирају од 1981, односно 1983. године,

када је Стојановић значајно допринела студији вегетације степског карактера. Поред тога, овај аутор је забележио присуство шибљака који претстављају остатке шумске вегетације на Тителском брегу. Од 1983. године забележени су фрагменти типичних ксеротермних шума хрста медунца.