Arch. Biol. Sci., Belgrade, 62 (3), 707-720, 2010 DOI:10.2298/ABS1003707K

DIVERSITY AND ECOLOGICAL DIFFERENTIATION OF OAK FORESTS IN NW THRACE (TURKEY)

A. KAVGACI[1], A. ČARNI[2], B. TECIMEN[3] and G. OZALP[4]

[1]*Southwest Anatolia Forest Research Institute,* PK 264 07002 Antalya, Turkey
[2]*Institute of Biology, Scientific Research Center of Slovenian Academy of Sciences and Arts,* 1000 Ljubljana, Slovenia
[3]*Department of Soil Science and Ecology of Forestry, Faculty of Istanbul University,* 34495 Bahçeköy, Istanbul, Turkey
[4]*Department of Silviculture of Forestry, Faculty of Istanbul University,* 34495 Bahçeköy, Istanbul, Turkey

Abstract - Quercus robur, Q. frainetto, Q. cerris and *Q. petraea* that predominate in forests in the Thrace region, a bridge between the Balkans and Anatolia, were sampled, elaborated and classified. The ecological conditions were estimated by bio-indicator values. Oak forests can be divided into four groups: *Q. robur-Fraxinus angustifolia* forests thriving in floodplains, *Q. petraea* forests found at higher altitudes, *Q. frainetto-Carpinus orientalis* forests appearing in the warmest and driest sites and *Q. frainetto* forests on more humid sites. It was established that the most important topographic factor is altitude, while slope and aspect are of minor importance.

Keywords: Biodiversity, ecology, floodplain, phytogeography, thermophilous forest, vegetation.

UDC 580.2

INTRODUCTION

The genus *Quercus* is represented by 18 species in Turkey (Davis, 1965-1985; Davis et al., 1988; Yaltırık, 1984). Many of these *Quercus* species also appear in Thrace and some of them, such as *Quercus frainetto*, *Q. cerris*, *Q. petraea*, *Q. robur*, *Q. hartwissiana*, *Q. pubescens*, *Q. infectoria* and *Q. coccifera*, comprise a large proportion of forests in the region (Dönmez, 1968; Eliçin, 1983).

In Thrace, oak-dominated forests appear in floodplains, in the lowlands and hilly regions, while in the mountainous zone they are in contact with *Fagus orientalis* forests (Yarci, 2000). Floodplain forests are specific forest communities with a particular species composition related to the habitat formed on an alluvial plain. There are some regional differences, but the communities have an azonal character and, in spite of some regional characteristics, are individually fairly unique all over the Mediterranean region (Brullo and Spampinato, 1999; Klimo and Hager, 2001).The vegetation in the lowland and hilly region of Thrace is dominated by mixed oak forests called *Salvio forskhali-Quercetum cerris quercetosum frainetto* (Akman et al., 1979; Quezel et al., 1992; Aydin et al., 2008) that resemble the oak forests of the Balkan Peninsula (Bergmeier and Dimopoulos, 2008; Butorac et al., 2008; Čarni et al., 2009).

Apart from its historical importance, this region is important from a phytogeographical point of view, since the "oriental" component of the Balkan flora reached southeast Europe via the Thracian plain while some species only reached Thrace and did not pass further to the west (Magyari et al., 2008). It was therefore expected that the vegetation would mediate between the vegetation of Anatolia and that of the Balkans.

There are only a few publications about the forest vegetation of Thrace (Yaltirik et al., 1983; Yarci, 2000); some additional information is also available from surveys of the forest vegetation of Turkey (e.g. Mayer and Aksoy, 1986; Akman, 1995; Çolak et al., 2007), but no work exists that offers an insight into the floristic composition and ecological conditions of the oak forests of Thrace. Such a work is needed to enlarge the general knowledge of the flora and vegetation of southeast Europe, especially in the transitional zone to Anatolia. Knowledge of forests, their species composition and ecological conditions would also offer a basis for forestry practice and maintaining of biodiversity.

The aim of our work was to sample and elaborate the oak forests in NW Thrace. We tried to discover which oak species make up the forests in the region, to define their floristic and ecological diversity and to establish their distribution pattern. We attempted to identify the most important ecological and topographical factors that cause the diversity of oak forests. We treated the forests in the broader geographical context of the transitional zone between southeast Europe and Anatolia. The research provides a basis for nature protection and for the sustainable management of forests.

MATERIAL AND METHODS

Study area

The study was undertaken in NW Thrace, which is composed of a mountainous part and lowland. The Istranca (Yildiz) mountain range is parallel to the coastline and is covered in the lower part by mixed oak forests. In the lowland, there is the well-known Igneada region, one of the most important plant areas of Turkey, due to its biological and ecological richness. It contains floodplain forests, lakes, swamps, scrub communities and sand dunes. However, the upper part of the mountains is mainly dominated by *Fagus orientalis*. (Özhatay et al., 2003)

The average annual rainfall is about 800 mm and the average temperature is 13ºC. The hottest month is August and the coldest month is February (Anon., 2006). According to the Thornthwaite (1948) climate system, the research area has a humid and mesothermal sea climate. The bedrock is mainly formed by sedimentary rocks such as alluvial, calcareous rocks, noncalcareous and pliocene sedimentary rocks, dunes and siltstone flischists (Kantarcı, 1979; Sevgi, 2005).

Analysis of vegetation data

The field work was carried out between 2003 and 2006. We sampled thermophilous oak forests dominated by *Q. frainetto*, *Q. petraea* and *Q. cerris*, as well as floodplain forests with a high abundance of *Q. robur.* We tried to include in our analysis all types of oak forests in the region. We chose homogenous sampling plots with an area of 400 m^2. The protocol of each plot includes general, topographic and other data of individual plots, such as altitude, inclination, aspect, vegetation cover (total and of individual layers) and a list of all vascular plants, in which a cover value was assigned to each species according to the nine degree Braun-Blanquet scale (Braun-Blanquet, 1964; Westhoff and van der Maarel, 1973).

The samples (hereinafter relevés) were stored in the TURBOVEG database management program (Hennekens and Schaminée, 2001). The hierarchical classification of the data set was carried out in the computer program SYN-TAX (Podani, 2001). The Bray-Curtis distance was used as a resemblance measure for the analysis and the beta-flexible algorithm with β :-0.25 for dendrogram construction. Different levels of division were accepted in the dendrogram, resulting in four clusters interpretable in terms of ecology. Additionally, the diagnostic species of the accepted clusters were identified by a fidelity measure in the JUICE program (Tichý, 2002). The threshold of the phi value was subjectively selected at 0.50 for a species to be considered as diagnostic (Chytrý et al., 2002). Determination of the higher syntax was performed according to Aydin et al., (2008) and the characteristic species of the higher syntax were defined in accordance with Akman (1995).

The results of the classification were visualized by ordination techniques in the CANOCO 4.5 package (ter Braak and Šmilauer, 2002). Principal Component Analysis (PCA), which is an indirect ordination method assuming a linear response of species to the environment, was run due to the low heterogeneity in the matrix of species (Lepš and Šmilauer, 2003). Since it was seen in the first step of the analysis that the floodplain *Q. robur-Fraxinus angustifolia* forests form a strictly separated group, distinct from other thermophilous oak forests, they were excluded from further analysis.

PCA analysis was then performed again only for thermophilous oak forests, in order to reveal their ordination more clearly. Unweighted average indicator values were used for further interpretation of ecological conditions (Zelnik and Čarni, 2008). Values were calculated using bio-indicator values (Pignatti, 2005) in the Juice program. These and topographic factors, such as aspect, altitude and inclination, were used as explanatory variables and projected passively onto the ordination plane. Although the bio-indicator values were selected for Italy, they are useful and often used also for Balkan vegetation (Košir et al., 2008; Tsiripidis et al., 2007). Correlations between PCA relevé scores and explanatory variables were calculated using the non-parametric Kendall coefficient in STATISTICA (Anon., 2007).

Additionally, redundancy analysis (RDA), a linear and direct ordination technique used because the gradient of relevés is narrow (Lepš and Šmilauer, 2003), was chosen to show correlations between relevés and variables that were measured in the field (aspect, altitude and inclination). The unrestricted Monte Carlo test with 9999 permutations was also used to test the statistical significance of the variables.

Identification of the species was made according to the Flora of Turkey (Davis, 1965-1985; Davis et al., 1988) and a new syntaxon was described in accordance with the International Code of Phytosociological Nomenclature (Weber et al., 2000).

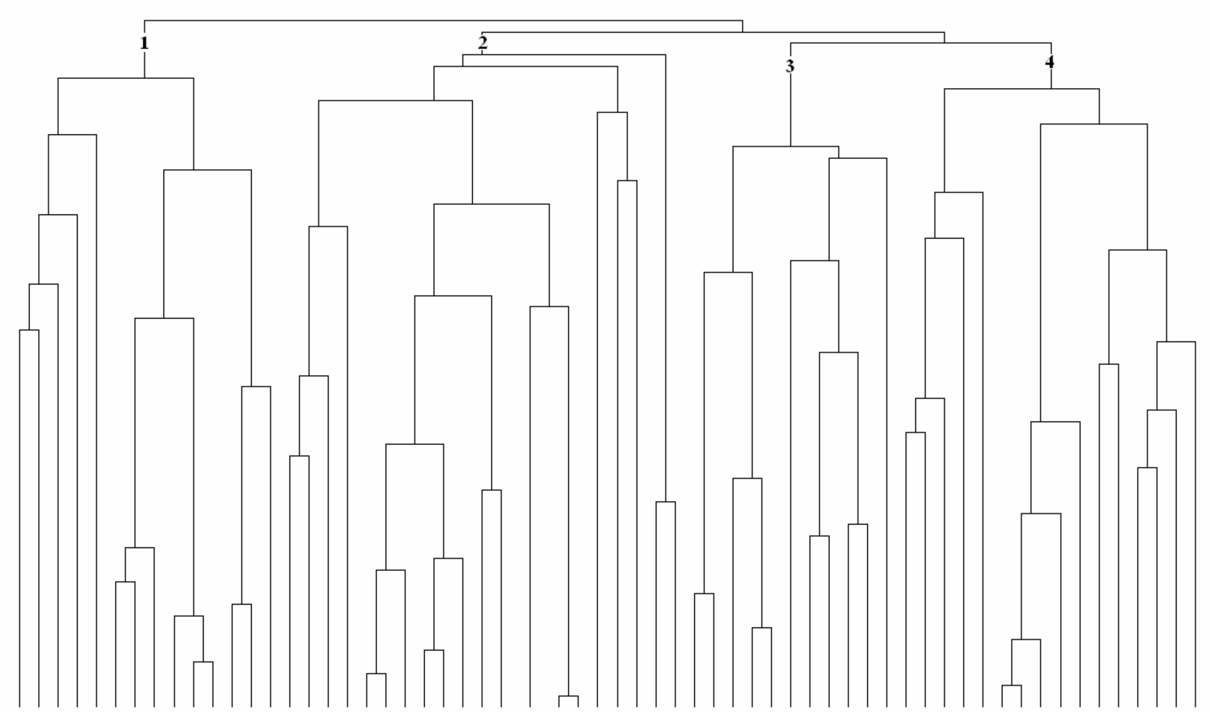

Figure 1. Hierarchical classification diagram of relevés of oak forests, Beta flexible method with Bray-Curtis as resemblance measure. Numbers correspond to the communities: 1. *Fraxinus angustifolia-Q. robur* dominated forest, 2. *Q. petraea* subsp. *iberica* dominated forest, 3. *Q. frainetto-Carpinus orientalis*-dominated forest and 4. *Q. frainetto*-dominated forest.

RESULTS

Classification

The classification of the database shows four clusters (Fig. 1). Diagnostic species of these clusters and vegetation table of the relevés are shown in Table 1.

Cluster 1 includes *Q. robur-Fraxinus angustifolia* subsp. *oxycarpa*-dominated forests. It is the most distinctly separated community in the dataset, characterized by many species, such as *Ulmus minor*, *Carpinus betulus*, *Rumex conglomeratus*, *Carex remota* and many others that show the high moisture status of the site.

Cluster 2 represents forests dominated by *Q. petraea* subsp. *iberica*. The diagnostic species of this community, such as *Festuca heteropylla*, *Tanacetum corymbosum* s. *cinereum*, *Galium paschale*, *Campanula persicifolia*, *Lathyrus niger* and *Epimedium pubigerum,* characterize dry and relatively cooler site conditions.

Cluster 3 contains *Q. frainetto-Carpinus orientalis*-dominated forests. The diagnostic species of this group is *Carpinus orientalis,* which appears on the warmest and driest sites within the studied forest types.

Cluster 4 includes *Q. frainetto*-dominated forests. Diagnostic species include heliophilous herb species, such as *Galium verum*, *Brachypodium pinnatum* and *Trisetum flavescens,* which indicate the favorable light and moisture conditions.

Fig. 2 shows that the floodplain *Q. robur-Fraxinus angustifolia*-dominated forests have a very different floristic composition from the thermophilous oak forests, due to their hygrophilous character. They were therefore excluded from further analysis.

The group of thermophilous oak forests was again elaborated using PCA with passive projection of explanatory ecological factors, in order to understand better the ecological conditions (Fig. 3a). Kendal's correlation coefficient revealed that ecological and topographic factors have a significant effect on thermophilous oak communities along both axes (Table 2). The first axis is significantly correlated with ecological factors, such as temperature, nutrients and moisture, whereas the second axis is related to topographic aspects, such as altitude, aspect, inclination and also light.

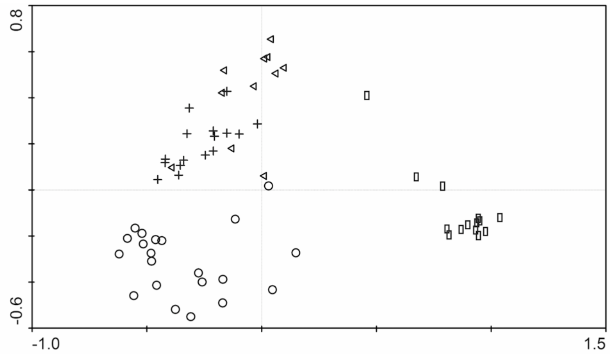

Figure 2. PCA ordination of all relevés. Legend: ▯ *Fraxinus angustifolia-Q. robur* dominated forest, ○ *Q. petraea* subsp. *iberica* dominated forest, ◁ *Q. frainetto-Carpinus orientalis* dominated forest, + *Q. frainetto* dominated forest.

In the diagram (Fig. 3a), the left part shows *Q. petraea*-dominated forests which are found at higher altitudes and the ecological conditions are least propitious, since moisture and nutrients are not available. In *Q. frainetto*-dominated forests, conditions are most favorable. There is the highest light, moisture and nutrient availability. *Q. frainetto-Carpinus orientalis*-dominated forests are found in the warmest sites with a well pronounced continental effect.

In the species ordination diagram (Fig. 3b), species of drier and cooler *Q. petraea*-dominated forests are on the left. These are followed in a clockwise direction by forests found in more favorable ecological conditions, dominated by *Q. frainetto*. Finally, species of the most thermophilous and continental forests, dominated by *Q. frainetto-Carpinus orientalis,* are shown.

Table 1. Vegetation table of the relevés . Group numbers correspond to the community numbers mentioned in the Figure 1. Legend: upper tree layer (1), lower tree layer (3), scrub layer (4) and herb layer (6). Coverage of the layers and localities of the relevés are submitted in the Appendix.

Group No	Layer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Running number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
Carici-Fraxinetum-quercetosum																																																															
Quercus robur	1	2	3	3	2	.	2	3	2	4	2	2	2	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex sylvatica	6	1	2	+	.	.	1	+	1	2	2	2	1	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carpinus betulus	1	.	.	.	.	.	3	3	3	3	4	4	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carpinus betulus	3	2	3	2	.	.	3	4	4	3	3	3	3	4	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Carpinus betulus	4	.	1	1	.	.	+	1	.	+	.	1	1	.	1	.	.	.	.	.	.	.	.	+	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.
Carpinus betulus	6	.	.	.	.	.	1	+	.	+	1	2	1	1	1	.	.	.	.	.	.	r	.	+	.	.	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fraxinus angustifolia subsp. oxycarpa	1	5	4	3	4	2	3	2	2	.	.	.	.	3	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fraxinus angustifolia subsp. oxycarpa	4	.	.	.	.	+	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fraxinus angustifolia subsp. oxycarpa	6	.	1	1	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	2	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	r	.	.	.	.	.	.	.
Smilax excelsa	4	r	1	2	.	.	2	1	2	2	1	1	2	3	2	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	+	.	+	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lamium maculatum	6	2	.	.	3	1	1	2	2	r	+	+	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex conglomeratus	6	1	2	1	1	+	2	1	2	r	1	.	.	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	r	.	2	.	.	.	.	.	.	.	.	.	.	.	.
Ulmus minor	3	1	3	1	4	1	.	2	.	2	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Ulmus minor	4	+	1	.	1	r	+	1	.	+	1	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Ulmus minor	6	+	1	.	+	.	+	+	.	+	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quercus robur	6	1	1	1	.	.	+	1	1	4	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex remota	6	1	2	2	.	.	.	.	1	+	1	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mercurialis perennis	6	3	.	2	+	.	2	2	1	.	3	+	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geum urbanum	6	+	+	r	1	1	.	r	.	1	+	1	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	r	.	.	.	.	.	.	.	.	.	.	.	.
Circaea lutetiana	6	1	.	.	.	.	.	.	1	1	1	.	+	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acer campestre	1	.	.	.	.	3	2	.	1	2	2	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acer campestre	3	1	2	1	.	1	.	4	1	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	r	.	.	.	.	.	.	.	2	1	.	.	.	.	.	1	.	.	.	.	.	.	1	r
Acer campestre	4	.	1	1	.	+	.	+	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.	.	.
Acer campestre	6	.	1	.	.	.	1	+	.	r	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.
Polygonatum latifolium	6	r	+	.	.	.	r	r	.	.	.	.	r	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Corylus avellana	4	2	.	.	.	.	.	.	r	1	1	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geranium robertianum	6	.	.	.	.	r	.	r	1	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glechoma hederacea	6	.	.	1	+	.	1	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Taneceto-Quercetum petraea																																																															
Quercus petraea subsp. iberica	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	5	5	5	3	4	4	3	3	4	5	1	2	2	2	2	.	4	.	4	4	2	2	.	.	.	4	.	.	.	2	2	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.
Quercus petraea subsp. iberica	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	2	.	.	.	.	1	.	1	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quercus petraea subsp. iberica	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	3	1	2	2	2	2	2	2	3	3	1	+	1	1	.	2	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quercus petraea subsp. iberica	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	1	1	2	1	2	1	+	.	+	1	+	.	1	.	1	+	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuca heterophylla	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	2	.	2	3	2	3	3	2	1	3	3	2	4	2	3	.	+	.	2	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	1	1	.	4	.	.	.	1	.	.	.
Tanacetum corymbosum subsp. cinere	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	+	r	1	r	1	+	.	+	+	.	+	1	.	.	+	.	.	+	+	.	.	r	.	.	.	.	.	.	.	r	.	.	.	.	.	.	+	.	.	.	.	.	+	r	.	.
Galium paschale	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	2	+	1	2	r	.	+	1	1	+	1	1	r	+	.	.	.	.	r	.	1	.	r	.	r	+	.	r	.	.	.	r	r	r	.	r	.	.	.	.	.	.
Campanula persicifolia	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	r	.	.	r	r	.	+	r	+	+	.	r	+	1	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	r	.	.	.	.	r
Lathyrus niger	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	+	+	+	+	+	1	r	+	+	+	1	1	.	+	+	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	r	1	+	.	.	+	.	+	.	.	1
Epimedium pubigerum	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	+	.	.	2	.	.	+	1	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Querco frainetto-cerris																																																															
Quercus frainetto	1	.	.	.	.	2	.	.	.	.	.	.	.	.	.	3	.	2	.	4	4	3	3	3	3	.	3	5	4	4	5	.	.	.	.	.	3	3	4	5	4	3	5	5	3	3	5	3	4	4	4	4	3	3	3	4	4	5	5	5	5	5	4
Quercus frainetto	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	1	.	.	.	2	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	.	.	1	.	1	.	.	1	.	1	.	.	.
Quercus frainetto	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	2	2	2	2	.	1	2	1	2	2	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	2	2	2	2	2	2	2	2	2	.
Quercus frainetto	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	2	1	1	.	+	1	1	3	1	.	.	+	.	.	.	.	+	2	2	.	1	.	.	.	3	1	1	1	1	1	1	1	.	.	.	1	1	+	.	+	1
Querco frainetto-cerris carpinetosum																																																															
Carpinus orientalis	3	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	5	5	4	4	.	4	4	4	3	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2
Carpinus orientalis	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	+	.	.	.	.	1	.	+	3	2	2	2	2	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	2
Carpinus orientalis	6	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Querco frainetto-cerris typichum																																																															
Galium verum	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	r	.	r	.	1	r	1	r	r	+	+	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	r	+	.	r	+	r	r	r	+	r	.	+	1	+	+
Trisetum flavescens	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	1	r	.	4	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	2	.	+	4	1	1	2	2	3	.	.	2	.	3
Brachypodium pinnatum	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	3	3	3	2	.	.	2	5	.	.	.	1	.	.	.	.	.	1	1	.	1	1	.	.	2	.	.	.	4	3	3	2	.	2	5	5	2	4	2	2	1	2	1	.
Alno-Quercion																																																															
Urtica dioica	6	+	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Carex divulsa	6	.	.	.	1	2	1	1	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Alliaria petiolata	6	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Populetelia alba																																																															
Arum italicum	6	.	.	.	+	.	.	r	.	r	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.

Table 1.- continued

Group No	Layer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Running number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
Quercion frainetto																																																															
Stachys thirkei	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	r	r	+	.	.	.	.	.	r	+	+	.	1	.	+	.
Ajuga laxmannii	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	+	+	.	.	r	.	.	.	.	.	.	1	.	+	.	.	.	.	.	r	.	.	r	+	.	.	.	r	.	.	+	.	+	+	.	+	+
Salvia forskahlei	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	.	.	1	1	+	2	1	+	+	2	1	2	2	2	.	2	.	.	.	2	.	r	1	.	.	.	.	.	.	.	.	.	+	.	.	1	1	1	1	1	1	r	+	2	.	2
Pyrus elaeagnifolia subsp. elaeagnifol	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	2	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	r	r	.	.	.	2	.	+	1	.	.
Sorbus domestica	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	+	1	.	1	1	1	+	1	+	1	+	+	+	1	1	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	r	.	1	1	1	1	1	1	1	1	1	.	1
Ferulago confusa	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	r	.	+	.	.	.	r	1	.	1	1	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	1	+	.	.	r	r	.	r
Stellaria holostea	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	2	.	.	.	r	r	r	+	.	.	.	.	.	.	.	.	.	1	1	.	.	+	.	1	.	.	.	.	1	r	.	r	+	.	2	.	.	+	.
Euphorbia amygdaloides	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	1	1	+	1	1	r	+	r	+	r	1	.	.	1	.	.	.	1	+	.	+	.	.	.	.	.	.	.	2	2	1	.	.	1	r	+	1	+	1	.	.	.	.	.
Genista tinctoria	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	+	+	+	1	+	r	r	+	.	1	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	+	+	+	+
Sorbus torminalis	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	.	1	.	1	1	.	.	1	.	.	1	.	1	.	.	1	.	.	.	.	.	.	+	.	.	.	.	.	.	.	r	+	.	.	.	r	.	.	.	.	.
Sorbus torminalis	4	.	.	.	.	.	.	.	.	.	.	.	.	+	r	2	1	.	1	+	1	.	1	.	2	1	2	1	.	.	.	+	3	.	+	.	1	.	.	.	.	.	.	+	.	.	1	.	.	.	.	.	.	r	.	.	.	+	2	.	.	.	.
Digitalis ferruginea	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypericum bityricum	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	.	r	r	r	1	1	.	.	.	.	.	r	+	r	.	.	.	.	r	+	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	.	.	+
Sorbus torminalis	3	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1	1	.	.	.	1	.	.	.	.	.	.	1	1	.	.	.	.	r	.	1	.	1	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
Fraxinus ornus subsp. ornus	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	1	1	+	1	1	3	.	+	2	2	+	.	.	r	+	.	.	.	1	1	+	+	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Fraxinus ornus subsp. ornus	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	2	.	2	.	1	.	1	2	1	1	2	2	2	.	.	.	.	.	.	2	1	3	3	1	1	3	2	3	.	.	.	.	.	.	.	.	.	.	4	.	2	1	2	2	1
Fraxinus ornus subsp. ornus	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	2	1	+	.	+	.	.	.	1	.	.	.	.	.	.	+	1	1	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Lychnis coronaria	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	+	.	r	.	r	.	r	.	.	.	.	.	.	.	.	.	.	.	.	r	+	.
Luzula forsteri	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	1	.	+	.	.	.	.	1	.	1	.	.	1	+	.	.	+	1	.	.	.	.	.	1	.	.	1	.	.	1	.	.	.	.
Quercetalia pubescentis																																																															
Centaurea stenolepis	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	r	+	.	.	r	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	r	1	r	2	1	.	.	+	.	.
Inula britannica	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	+	.	1	.	.	.	.	.	+	.	.	2	+	.
Teucrium chamaedrys	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	+	1	.	.	.	.	1	+	1	+	.	+	.	.	+	.	.
Vincetoxicum hirundinaria	6	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	1	r	+	+	.	1	2	.	.	.	.	.	.	.	r	.	.	.	.	r	.	.	.	.	.	1	1	1	1	r	1	r	+	.	.	.
Inula salicina	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	1	.	.	r	.	.	.	r	+	.	.	1	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	.	.	.	1	.	+	+	+	.
Genista carinalis	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	r	.	.	.	.	.	r	.	1	.	.	1
Muscari neglectum	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	r	+	.	r	.	.	.	.	.	.	r	r	.	.	.	r	.	+	.	+	+
Quercus cerris	1	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	2	2	2	2	2	.	.	3	.	5	3	5	.	.	4	3	4	.	3	.	.	.	3	3	.	4	3	3	3	3	4	3	4	4	3	.	.	.	.	1	2
Quercus cerris	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	1	1	1	.	.	1	.	4	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	2	1	2	1	2	.	.	.	.	.	.
Quercus cerris	6	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	+	.	.	1	.	.	1	1	.	.	.	.	+	.	1	.	.	.	.	.	.	1	1	1	1	1	1	1	.	.	.	.	.	.	.	.	.
Anthemis tinctoria subsp. tinctoria	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	1	r	.	.	+	r	+	r	r	.	+	.	.	.	.	.	.	.	r	.	+	.	.	.	+	.	.	.	.	.	.	.	.	r	r	r	.	r	+	r	+	r
Clinopodium vulgare	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	+	.	r	.	.	.	r	1	.	.	.	.	.	r	r	.	+	.	.	.	.	.	.	.	.	.	.	.	.	r	r	r	.	.	.	.	.	1	+	1
Hypericum perforatum	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	r	.	.	+	.	.	r	.	.	.	.	.	.	.	.	r	.	.
Silene italica	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	r	r	.	+	.	.	.	.	.	r	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	r	r	.	.	.	1
Carex flacca	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	4	2	2	3	.	1	2	2	2	2	2	3	3	.	2	+	2	1	.	.	3	2	+	2	1	1	1	.	1	+	.	.	.	.	.	2	2	1	1	.	.	2	2	4	4	2	3
Chamaecytisus supinus	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	r	r	+	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	1	.	.	.	.	.
Cephalanthera longifolia	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Querco-Fagatea																																																															
Rosa canina	4	.	1	1	.	.	.	.	.	.	.	r	.	.	.	.	.	+	.	.	+	.	.	.	.	.	r	+	.	.	+	.	.	+	.	.	r	.	.	r	.	+	.	.	.	+	.	1	.	.	r	.	1	r	.	+	.	1	r	.	+	r	r
Mycelis muralis	6	+	.	r	1	.	+	r	+	+	r	1	.	.	.	.	r	+	+	.	.	+	+	1	+	+	.	.	.	r	.	+	.	.	.	.	.	r	.	.	.	.	+	+	.	+	.	r	+	+	1	r	1	+	r	r	.	.	+	+	.	+	+
Crataegus monogyna	4	1	1	1	1	r	1	+	.	1	.	+	r	r	.	.	r	.	.	r	+	.	1	+	.	+	1	1	.	.	+	.	2	3	.	.	r	.	.	r	r	.	.	+	r	+	.	1	1	1	1	1	1	r	+	.	r	2	1	1	r	.	r
Rubus canescens	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	r	1	1	+	.	.	.	r	.	+	.	1	2	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	r	.	.	.	r	r	.	.	r	.	r	.	.
Lathyrus laxiflorus	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	r	+	1	1	.	+	r	+	+	1	.	+	.	.	.	+	1	r	+	.	.	.	.	.	.	.	.	r	.	.	.	1	+	r	.	.	.	+	.	r	+	1
Viola sieheana	6	2	3	.	.	.	2	1	1	2	2	1	2	+	.	.	1	.	1	1	.	1	1	1	1	+	+	.	.	1	+	.	1	.	.	.	1	+	1	1	+	.	.	.	.	.	.	2	+	1	.	.	1	+	1	+	+	1	1	+	.	.	+
Prunus domestica	4	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.	.	.
Cornus mas	4	1	.	.	1	+	.	1	.	1	+	.	1	+	.	.	.	.	.	.	.	r	.	+	.	.	.	1	.	.	.	.	1	1	.	.	r	r	.	+	1	+	1	1	.	.	.	1	.	r	2	.	r	.	.	2	+	r	.	.	.	+	r
Juncus effusus	6	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Mespilus germanica	4	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	r	.	+	.	.	r	.	r	.	.	.	.	.	r	.	1	r	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	1	r	.
Viola alba	6	.	.	+	.	.	1	1	1	+	1	1	1	.	.	+	1	.	2	1	1	1	1	1	.	+	+	1	+	1	.	.	1	+	.	.	1	1	1	1	1	r	.	+	+	.	1	.	1	.	r	.	1	1	1	r	.	1	1	+	1	+	+
Festuca drymeia	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	2	.	.	.	.	3	4	1	.	.	2	1	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tilia argentea	6	.	.	.	.	.	r	.	.	.	1	+	1	+	r	.	.	.	.	.	.	+	.	2	+	.	.	.	.	r	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trachystemon orientalis	6	.	.	.	.	.	.	.	1	+	.	+	+	.	.	1	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Platanthera bifolia	6	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fragaria vesca	6	.	.	.	.	.	.	.	.	r	r	+	.	.	.	r	.	.	.	1	r	+	.	+	1	r	.	.	1	+	.	.	1	.	.	.	.	r	1	1	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	1	.	.	.	.	.	1
Melica uniflora	6	.	.	+	.	.	1	2	1	+	1	1	+	+	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tamus communis	6	+	.	1	.	r	.	.	.	.	.	.	.	r	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	r	+	.	1	2	.	.	1	.	r	+	2	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	r
Allium paniculatum	6	.	.	.	.	r	.	.	.	.	.	r	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tilia tomentosa	4	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	r	.	r	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 1. - continued

Group No	Layer	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Running number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62
Primula vulgaris	6	.	.	.	.	.	1	.	1	.	.	+	.	.	.	r	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	+	.	.	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Hedera helix	4	1	1	1	.	1	1	1	1	1	2	2	2	3	3	.	+	.	.	.	.	.	.	.	1	1	.	1	1	.	.	.	1	.	r	+	1	1	2	1	1	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	1	.	.	.	+
Ligustrum vulgare	4	.	.	1	.	.	.	.	.	.	.	.	r	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	r	.	.	.	r	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Symphytum tuberosum	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	1	r	.	.	r	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.
Fritillaria pontica	6	.	.	.	.	.	.	r	.	.	.	r	r	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	r	.	.	.	.	.	.	r	.	.	.	.	.	+	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ruscus aculeatus	4	+	1	4	4	5	3	5	4	3	4	3	5	4	4	.	+	.	2	r	r	r	r	r	.	.	.	.	r	.	+	.	r	.	r	1	r	2	5	5	5	5	4	4	5	5	2	.	.	.	r	.	r	.	.	r	+	.	+	2	2	2	r
Fagus orientalis	4	.	.	.	.	.	.	.	.	.	.	r	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ruscus hypoglossum	4	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa nemoralis	6	.	.	.	.	.	1	.	.	1	2	1	.	.	.	1	+	+	2	.	.	.	.	.	.	+	1	.	.	.	1	.	1	3	.	.	.	.	.	.	1	1	.	.	1	.	.	.	.	.	.	.	2	.	2	.	.	2	2	.	.	.	.
Fagus orientalis	3	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	5	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Others																																																															
Agrostis stolonifera	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	2	2	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	3	2	2	.	2	3	.	.	+	.	.	.
Oenanthe silaifolia	6	.	.	1	1	.	2	r	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	r	.	.	+	.	.	.	r	+	1	+	3	+	.	.	.	.	r	.	+	2	3	2
Lolium perenne	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	r	.	.	.	.	.	.	.	.	.	.	.
Trifolium hybridum subsp. hybridum	6	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	r	+	.	+	+	.	.	.	.	.	.	.	.	.	.	r
Cirsium vulgare	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	.	.	.	.	.	.	.	.	.	.	.	.	r	.
Anthoxanthum odoratum	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	2	1	2	.	.	1	1	.	.	.	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2	.	.	1	1	.	.	.	+	1
Polygala supina	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	.	r
Dorycnium graecum	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	.	r	.	.	.	.	.
Dactylis glomerata	6	+	.	2	+	1	1	2	1	+	+	1	.	.	.	1	1	+	2	3	3	2	2	3	2	2	2	3	3	2	2	+	2	1	+	.	2	1	r	1	.	1	.	1	.	+	1	1	2	1	2	2	2	2	2	2	2	2	+	1	2	2	3
Verbascum blattaria	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	r
Dianthus calocephalus	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r
Centaurium erythraea	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	+
Trifolium panonicum subsp. elongatum	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+
Cistus creticus	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r
Poa trivialis	6	+	+	2	1	1	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	2	.	.	.	.	1	.	.	.	2	2	2	.	+	.	1	1	.	2	.	.	.	2	2	.	.	2	.	.	1	1
Campanula sparsa	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	+	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	r
Luzula multiflora	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	.
Prunella vulgaris	6	.	1	2	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Geranium lucidum	6	.	.	.	2	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	+	.	.	.	.	.	r	r	+	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	+	.	.
Sanicula europaea	6	1	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lysimachia punctata	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Galium aparine	6	r	.	.	.	.	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lysimachia nummularia	6	.	.	1	1	.	+	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubus hirtus	4	.	.	.	.	.	1	.	.	.	1	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orobanche caryophyllacea	6	r	.	.	.	r	.	.	.	1	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.
Festuca gigantea	6	.	.	2	.	.	.	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leontodon tuberosus	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Veronica serpyllifolia	6	r	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Listera ovata	6	+	.	.	.	.	.	r	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachypodium sylvaticum	6	r	.	.	1	.	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ajuga reptans	6	+	.	.	.	.	.	+	.	.	1	1	+	+	+	.	r	.	1	.	.	+	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	+	.	r	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sedum telephium	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Holcus lanatus	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euphorbia stricta	6	r	.	.	.	r	.	.	+	.	1	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	+	.	.	.	.	+	.	1	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.
Ornithogalum sphaerocarpum	6	.	.	r	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scutellaria albida	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	r	r	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.
Veronica chamaedrys	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	1	.	.	.	.	+	+	1	+	.	.	.	.	+	+	.	+	+	+	+	.	.	.	.	.	r	.	.	.	.	.	.	.	+	.	1	.	.	+	.
Ranunculus constantinapolitanus	6	+	.	+	.	.	1	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	+	.	.	+	.	1	+	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+
Euonymus europaeus	4	r	.	.	.	.	.	.	.	+	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cruciata laevipes	6	.	.	+	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Other species with low frequency : *Quercus robur* [4] 13: +; *Fraxinus angustifolia subsp. oxycar* [3] 1: 1, 5: 2; *Corylus avellana* [3] 1: 3; *Quercus robur* [3] 7: 1; *Myrrhoides nodosa* [6] 4: +; *Carpinus orientalis* [1] 4: 1; *Physalis alkekengi* [6] 35: r; *Mentha aquatica* [6] 35: +; *Chaerophyllum temulum* [6] 8: +; *Parietaria officinalis* [6] 1: +; *Iris pseudacorus* [6] 5: +; *Rubus caesius* [4] 4: r; *Sambucus nigra* [4] 4: 1; *Phleum pratense* [6] 41: 1, 47: +; *Pyrus elaeagnifolia subsp. elaeagni* [3] 38: r, 42: 1; *Fraxinus ornus ssp. ornus* [1] 46: 1; *Sorbus domestica* [6] 22: 1, 46: 1; *Sorbus domestica* [3] 27: 1, 36: 1; *Quercus cerris* [3] 23: 1; *Prunus domestica* [3] 61: 1, 43: r; *Vitis vinifera ssp. sylvestris* [4] 23: +, 62: 1; *Fagus orientalis* [1] 59: 2, 60: 3; *Tilia tomentosa* [1] 12: 3, 60: 1; *Rhododendron ponticum* [4] 59: +; *Fagus orientalis* [6] 59: +; *Daphne pontica* [4] 60: 1; *Hieracium hoppeanum* [6] 33: +, 41: 1; *Anthemis cotula* [6] 34: r, 35: 1; *Cynosurus cristatus* [6] 34: 1, 41: 2; *Vicia villosa* [6] 43: r; *Capsella bursa-pastoris* [6] 35: +; *Plantago major* [6] 35: +; *Cynosurus echinatus* [6] 35: 1; *Chenopodium polyspermum* [6] 35: 1; *Trifolium medium ssp.*

Ordination

An attempt was also made to evaluate the importance of topographical factors measured in the field, in order to understand the distribution of samples in the ordination diagram (Table 3). As a result of this analysis, it was seen that altitude is the only significant topographical factor, and aspect and inclination are of minor importance.

DISCUSSION

The distribution pattern of oak forests in the region was ascertained. *Q. robur-Fraxinus angustifolia*-dominated forests can be found on nutrient rich, humid sites in floodplain areas. They are characterized by species with a Euro-Siberian distribution pattern. They are very different from other oak forests in the region. *Q. petraea*-dominated forests can be found on the coolest, least favorable and highest sites of thermophilous oak forests in the region. They correspond to the physiological optimum of *Q. petraea,* which is less adapted to warm, dry habitats than *Q. frainetto* (Manes et al., 2006; Sisó et al., 2001). *Q. frainetto-Carpinus orientalis*-dominated forests appear on the warmest sites in the region with moderate inclination. These forests are the most continental ones here, as is evident from the presence of *Carpinus orientalis,* which is a species of continental character (Blasi et al., 2001). *Q. frainetto*-dominated forests are found on the most favorable conditions of all thermophilous oak forests. The high light availability may be related to the high degradation of these forests.

Q. robur-Fraxinus angustifolia-dominated forests are found on an alluvial plain. This vegetation is to some extent azonal and its composition is therefore similar to that in other south European regions (Brullo and Spampinato, 1997, 1999; Pavlov and Dimitrov, 2002; Vukelić and Baričević, 2004). We classified the communities into *Carici remotae-Fraxinetum oxycarpae,* which is an association of the alliance *Alno-Quercion*, with the synonym *Fraxinion angustifoliae*.

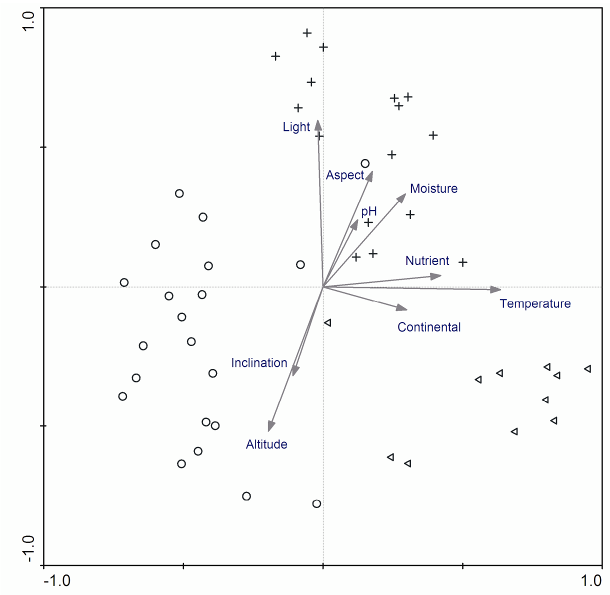

Figure 3a. PCA ordination of relevés of thermophilous oak forests. Legend corresponds to Figure 2.

Thermophilous oak forests in the region show a typical feature of the oak forests of southeastern Europe. Thermophilous oak forests in the central Balkans are divided into two groups/alliances, one of low altitudes dominated by *Q. frainetto* and Q. *cerris* (alliance *Quercion frainetto*), and the other dominated by *Q. petraea* and *Q. cerris* (alliance *Quercion petraea-cerris*) at higher altitudes (Kojić et al., 1998; Čarni et al., 2009). In our region, the division into two alliances is not suitable and we classified all thermophilous forests into a single alliance *Quercion frainetto*. Barbero et al., (1976) divided *Q. frainetto*-dominated forests in the Balkans into two groups/alliances, of which one is more continental (alliance *Quercion frainetto*) and the other Mediterranean (alliance *Melitti-Quercion frainetto*). *Q. frainetto*-dominated forests of the European part of Turkey should be classified into the continental group (Akman et al., 1979). Thermophilous oak forests in the region show a typical feature of the oak forests of southeastern Europe. Thermophilous oak forests in the central Balkans are divided into two groups/alliances, one of low altitudes dominated by *Q. frainetto* and *Q. cerris*

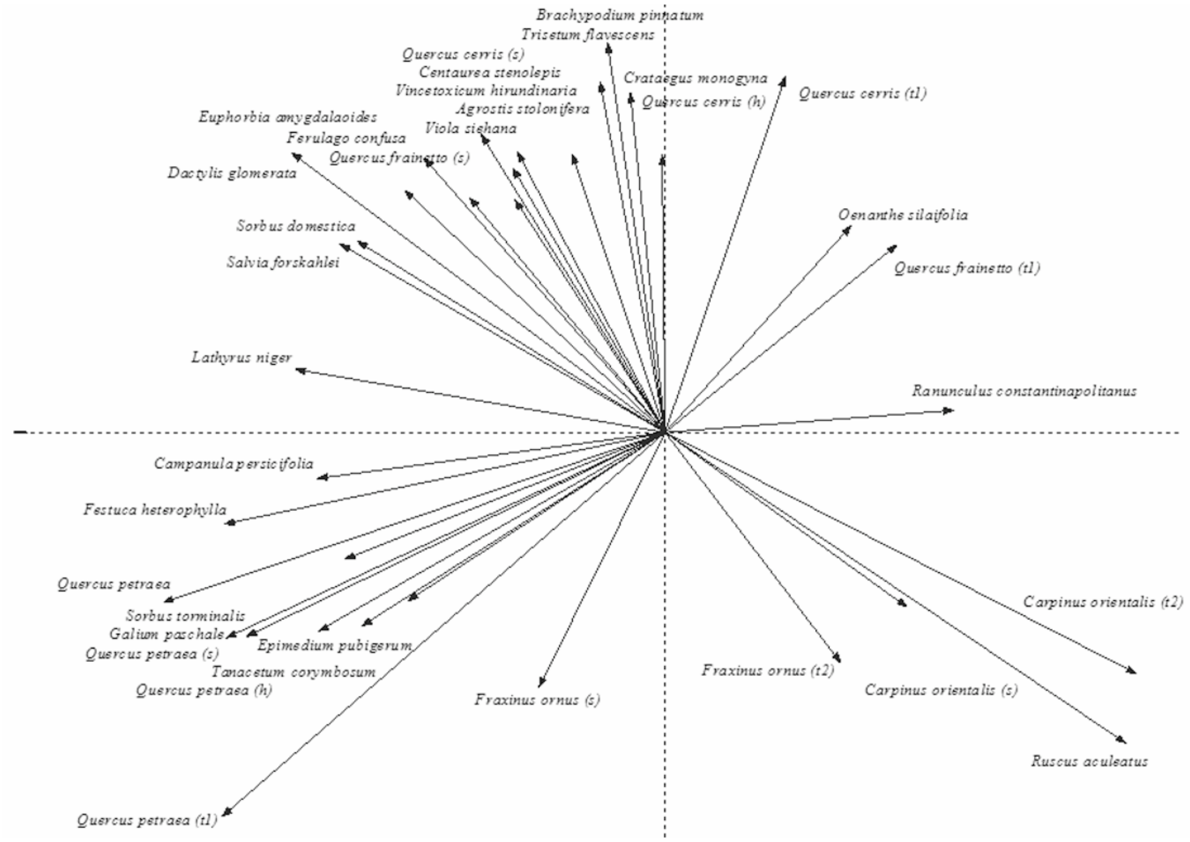

Figure 3b. PCA ordination of species of thermophilous oak forests. Legend: t1, t2, s, and h symbolize upper tree, lower tree, scrub and herb layers, respectively; herb species always appear in the herb layer.

Table 2. Kendal correlation coefficients (weighted correlation) between first two PCA axes and environmental variables. Legend: *** means p<0.001, ** means p<0.01, * means p<0.05.

	Light	Temperature	Continent	Moisture	pH	Nutrient	Aspect	Altitude	Inclination
Axis 1	-	***	-	*	-	**	-	-	-
Axis 2	***	-	-	-	-	-	**	***	**

Table 3. Results of forward selection: environmental variables and the percentage of total variance of species data explained by RDA analysis.

Variable	Var.N	LambdaA	P	F
Altitude	2	0.06	0.002	2.78
Aspect	1	0.02	0.154	1.31
Inclination	3	0.03	0.268	1.15

(alliance *Quercion frainetto*), and the other dominated by *Q. petraea* and *Q. cerris* (alliance *Quercion petraea-cerris*) at higher altitudes (Kojić et al., 1998; Čarni et al., 2009). In our region, the division into two alliances is not suitable and we classified all thermophilous forests into a single alliance *Quercion frainetto*. Barbero et al., (1976) divided *Q. frainetto*-dominated forests in the Balkans into two groups/alliances, of which one is more continental (alliance *Quercion frainetto*) and the other Mediterranean (alliance *Melitti-Quercion frainetto*). *Q. frainetto*-dominated forests of the European part of Turkey should be classified into the continental group (Akman et al., 1979).

Q. frainetto and *Q. frainetto-Carpinus orientalis*-dominated forests can be classified within the sub-association of *Salvio forskhali-Quercetum cerridis quercetosum frainetto*. This community has been described in the eastern Marmara region (Akman et al., 1979) but it seems that it is distributed over the majority of the Marmara Region. It shows common features with the forests of the Balkans, with many species characteristic of thermophilous deciduous forests. However, it is differentiated by some Anatolian species, such as *Salvia forskhali,* which are not distributed in other parts of the Balkans.

On the basis our analyses, we divided *Salvio forskhali-Quercetum cerridis quercetosum frainetto* into two ecological variants: *Carpinus orientalis*-variant (*Q. frainetto-Carpinus orientalis*-dominated forests) and *Galium verum*-variant (*Q. frainetto*-dominated forests). The *Carpinus orientalis* variant is found on the driest and most continental sites and is characterized by co-dominance of *Carpinus orientalis*. The *Galium verum* variant is found in the most favorable site conditions and is characterized by the presence of *G. verum*, *Trisetum flavescens* and *Brachypodium pinnatum*.

Q. petraea subp. *iberica*-dominated forests show similar features to those from Belgrade Forest near Istanbul, which was incorrectly classified as *Q. petraea* subsp. *iberica-Lathyrus niger* association (Yaltirik et al., 1983; Weber al., 2000). Aydin et al., (2008) classified *Q. petraea* s. *iberica*-dominated forests from the same locality as *Salvio forskhali-Quercetum cerridis quercetosum frainetto*. According to our analysis, *Q. petraea* subsp. *iberica*-dominated forests show a different floristic composition and ecological conditions from *Salvio forskhali-Quercetum cerridis quercetosum frainetto* and should therefore be treated as an independent association. Since *Lathyro nigri-Quercetum petraea* (Baričević et al., 2006) already exists, it was decided to classify the *Q. petraea subsp. iberica*-dominated forests into *Taneceto cinerei-Quercetum petraea* subsp. *ibericae* ass. nova. These communities have a different floristic structure from the *Q. petraea* dominated forests described in Anatolia (Yurdakulol et al., 2002; Türe et al., 2005). The holotype of this association is relevé 17 in Table 1 (Holotypus hoc loco: Tab. 1/17), the diagnostic species are *Festuca heteropylla*, *Tanacetum corymbosum* subsp. *cinereum*, *Galium paschale*, *Campanula persicifolia*, *Lathyrus niger* and *Epimedium pubigerum*; they characterize dry and relatively cooler site conditions. This association corresponds to Cluster 2 in the text.

So the syntaxonomical scheme of the *Quercus* communities in NW Thrace can be submitted as follow:

Querco-Fagetea Br.-Bl.&Vlieger 1937

Populetalia alba Br.-Bl. ex Tchou 1948

Alno-Quercion roboris Horvat 1950

1) *Carici remotae-Fraxinetum oxycarpae* Pedroti 1970

Quercetalia pubescenti-petraeae Klika1933

Quercion frainetto Horvat (1954) 1959

2) *Taneceto cinerei-Quercetum petraea* subsp. *ibericae* Kavgaci et al., ass.nova

3) *Salvio forskhali-Quercetum cerridis quercetosum frainetto* Akman et al., ex Quezel et al., 1992 var. *Carpinus orientalis*

4) *Salvio forskhali-Quercetum cerridis quercetosum frainetto* Akman et al., ex Quezel et al., 1992 var. *Galium verum*

In conclusion, this work brings new data about oak-dominated forests in Thrace, which have not previously been elaborated. This enlarges our knowledge of the forest vegetation of Thrace and provides a basis for nature protection and for the sustainable management of the forests. At the same time, it also confirmed that the standard Braun-Blanquet method is a useful tool for forest site classification in Turkey.

Acknowledgements - We would like to thank the Forestry Faculty of Istanbul University and the Scientific Research Center of the Slovenian Academy of Sciences and Arts for logistic support. The authors acknowledge the financial support from the state budget by the TUBITAK project (TOVAG 3313) and by the Slovenian Research Agency (project No. P1-0236)

REFERENCES

Akman, Y. (1995). Türkiye Orman Vejetasyonu. Ankara Üniversitesi Fen Fakültesi, Ankara.

Akman, Y., Barbéro. M., and *P. Quézel* (1979). Contribution à l'étude de la végétation forestière d'Anatolie méditerranéenne. *Phytocoenologia,* 5(2):189-276.

Anon., (2006). The data of Kumkoy Meteoroloji Station. Istanbul.

Anon., (2007). STATISTICA (data analysis software system). Version 8.0. StatSoft, Inc., www.statsoft.com

Aydın, C. T., Bergmeier, E., and *H. Walentowski* (2008). Vegetation und Standort in der Waldlandschaft der Nordwest-Türkei. Önel Druck&Verlag, Köln.

Barbéro, M., and *P. Quézel* (1976). Les groupements forestière de Grèce centro-méridionale. *Ecol Medit*, 2:1-86.

Baričević, D., Vukelić, J., Pernar, N., Bakšić, D., and *M. Sango,* (2006). Association *Lathyro-Quercetum petraeae* I. Horvat (1938) 1958 in the Požega hill area and its comparison with other distribution areas in Croatia. *Period Biol*, 108:683-692.

Bergmeier, E., and *P. Dimopoulos* (2008). Identifying plant communities of thermophilous deciduous forest in Greece: species composition, distribution, ecology and syntaxonomy. *Plant Biosyst*, 142(2):228-254.

Blasi, C., Di Pietro, R., Filesi, L., and *P. Fortini* (2001). Syntaxonomy, chorology and dynamics of *Carpinus orientalis* communities in Central Italy. *Phytocoenologia*, 31:33-62.

Braun-Blanquet, J. (1964). Pflanzensoziologie. Grundzüge der Vegetationskunde. 3rd ed. Springer, Wien.

Brullo, S., and *G. Spampinato* (1997). Indagine fitosociologica sulle ripisilve della Calabria (Italia meridionale). *Lazaroa*, 18:105-151.

Brullo, S., and *G. Spampinato* (1999). Syntaxonomy of hygrophilous woods of the *Alno-Quercion roboris*. *Ann Di Bot*, 57: 133-146.

Butorac, B., Igić, R., Anaćkov, G., Zlatkovič, B., Dragana, V. and *P. Boža* (2008). Orno-Cotino-Quercetum pubescentis ass. nova. prov. on the slopes of Title Hill (Serbia). *Arch. Biol Sci,* Belgrade, 60(1): 83-92.

Čarni, A., Košir, P., Karadžić, B., Matevski, V., Redžić, S., and *Ž. Škvorc* (2009). Thermophilous deciduous forests in Southeastern Europe. *Plant Biosyst*, 143(1):1-13.

Chytrý, M., Tichý, L., Holt, J., and *Z. Botta-Dukát* (2002). Determination of diagnostic species with statistical fidelity measures. *J Veg Sci*, 13:79-90.

Çolak, A., and *I. D. Rotherham* (2007). Classification of Turkish forests by altitudinal zones to improve silvicultural practice: a case-study of Turkish high mountain forests. *Int For Rev*, 9(2):641-652.

Davis, P. H. (1965-1985). Flora of Turkey and the East Aegean Islands. Vol. 1-9, Edinburgh Univ. Press, Edinburgh.

*Davis, P. H., Mill, R. R.,*and *K. Tan* (1988). Flora of Turkey and the East Aegean Islands. Vol. 10, Edinburgh Univ. Press, Edinburgh.

Dönmez, Y. (1968). Trakya'nın bitki coğrafyası. İstanbul Univ Yay, No 1321, İstanbul

Eliçin, G. (1983). Işık Dağı (Ganos-Tekirdağ)'nın Florası. İÜ Orman Fakültesi Yayını, İstanbul.

Hennekens, S. M., and *J. H. J. Schaminée,* (2001). TURBOVEG a comprehensive data base management system for vegetation data. *J Veg Sci*, 12:589-591.

Kantarcı, M. D. (1979). Kuzey Trakya Dağlık Orman Yetişme Bölgesinin Yöresel Sınıflandırması. *İst Üni Orman Fak Der*, A/29(2):42-71.

Kojić, M., Popović, R., and *B. Karadžić,* (1998). Sintaksonomski pregled vegetacije Srbije. Institut za biološka istraživanja »Siniša Stanković«, Beograd.

Klimo, E., and *H. Hager* (ed) (2001). The floodplain forests in Europe. Current situation and perspective. *Eur For Inst Res Rep*, 10. 268 p.

Košir, P., Čarni, A., and *P. Di Romeo,* (2008). Classification and phytogeographical differentiation of noble hardwood forests in Southeastern Europe. *J Veg Sci*, 19:331-342.

Lepš, J. and *P. Šmilauer* (2003). Multivariate analysis of ecological data using CANOCO, Cambridge University Press, Cambridge.

Magyari, E. K., Chapnam, J. C., Gaydarska, B., Marinova, E., Deli, T., Huntly, J. P., and *Allen, J. R. M.*, and *B. Huntley* (2008). The 'oriental' component of the Balkan flora: evidence of presence of the Thracian Plain during Weichselian late-glacial. *J Biogeogr*, 35(5):865-883.

Manes, F., Vitale, M., Donato, E., Giannini, M., and *G. Puppi* (2006). Different ability of three Mediterranean oak species to tolerate progressive water stress. *Photosynthetica*, 44:387-393.

Mayer, H., and *H. Aksoy* (1986). Wälder Türkei. Gustav Fischer Verlag, Stuttgart.

Özhatay, N., Byfield, A., and *S. Atay,* (2003). Türkiye'nin Önemli Bitki Alanları. Doğal Hayatı Koruma Vakfı (WWF Türkiye) yayını, İstanbul.

Pavlov, D., and *M. Dimitrov* (2002). A syntaxonomic analysis of the floodplain forests in the maintained reserves "Dolna Topchiya" and "Balabana". *Hayka ГОРОТА* (Forest Science) 1:3-19.

Pignatti, S. (2005). Valori di bioindicazione delle piante vascolari della flora d'Italia. *Braun-Blanquetia*, 39:1-97.

Podani, J. (2001). SYN-TAX – 2000, Computer programs for data analysis in ecology and systematics, Scientia Publishing, Budapest.

Quézel, P., Barbéro, M., and *Y. Akman* (1992). Typification de syntaxa décrits en région méditerranéenne orientale. *Ecol Medit*, 18:81-87.

Sevgi, O. (2005). Soil Characteristics of Different Sites in Stranja (Yildiz) Mountain. In: UESCO-BAS-MOEW Bulgarian – Turkish Workshop on Challenges of Establishment and Management of a Trans-Border Biosphere Reserve between Bulgaria and Turkey in Strandzha Mountain (Ed: N. Chipev) 151 p.

Sisó, S., Camarero, J. J., and *E. Gil-Pelegrin* (2001). Relation between hydraulic resistance and leaf morphology in broadleaf *Quercus* species: a new interpretation of leaf lobation. *Tree-Struct Funct*, 15:341-345.

Ter Braak, J. F. C., and *P. Šmilauer* (2002). CANOCO Reference Manual and CanoDraw for Windows User's Guide, Software for Canonical Community Ordination (version 4.5), Wageningen.

Thornthwaite, C. W. (1948). An approach toward a rational classification of climate. Geogr Rev 38:55-94.

Tichý, L. (2002). JUICE, software for vegetation classification. *J Veg Sci*, 13:451-453.

Tsiripidis, I., Bergmeier, E., and *P. Dimopoulos* (2007). Geographical and ecological differentiation in Greek Fagus forest vegetation. *J Veg Sci*, 18:743-750.

Türe, C., Tokur, S., and *O. Ketenoglu* (2005). Contribution to the syntaxonomy and ecology of the forest and shrub vegetation in Bithynia, Northwestern Antolia, Turkey. *Phyton-Ann Rei Bot A*, 45(1):81-115.

Vukelić, J., and *D. Baričević* (2004). The association of spreading elm and narrow-leave ash (*Fraxino-Ulmetum laevis* Slav. 1952) in floodplain forest of Podravina and Podunavlje. *Hacquetia*, 3:49-60.

Weber, H. E., Moravec, J., and *J. P. Theurillat* (2000). International code of phytosociological nomenclature. 3rd edition. *J Veg Sci*, 11:739-768.

Westhoff, V., and *E. Van Der Maarel* (1973). The Braun-Blanquet approach. In: Handbook of Vegetation Science 5, Ordination and classification of communities, (Ed. R. H. Whittaker), 617-726. Junk, The Hague.

Yaltırık, F. (1984). Türkiye meşeleri teşhis kılavuzu. Orman Genel Müdürlüğü Yayını, Ankara.

Yaltirik, F., Akman, Y., and *O. Ketenoğlu* (1983). A phytosociological research in the Belgrad forest. *Comm Fac Sci Univ*, C(1):1-9.

Yarci, C. (2000). Demirköy (Istranca Dağları/Trakya Bölgesi) ve civarının orman vejetasyonu. *Ekoloji Çevre Derg*, 9(35):13-18.

Yurdakulol, E., Demirors, M., and *A. Yildiz* (2002). A phytosociological study of the vegetation of Devrekani-Inebolu-Abana areas (Kastmanonu, Turkey). *Israel J Plant Sci*, 50(4):293-311.

Zelnik. I., and *A. Čarni* (2008). Wet meadows of the alliance *Molinion* and their environmental gradients in Slovenia. *Biologia*, 63:187-196.

APPENDIX

Localities of the relevés and coverage of the layers in the Table 1. Running number, Upper tree layer (%), lower tree layer (%), scrub layer (%), herb layer (%), aspect, altitude (m), inclination (%), latitude, longitude and sampling date are presented respectively (relevé size: 400m^2).

1: 100, 70, 20, 70, E, 10, 5, 577889, 4635763, 25.06.2004; 2: 90, 70, 3, 80, NE, 4, 1, 582013, 4629309, 20.06.2003; 3: 80, 50, 70, 30, SE, 5, 2, 582275, 4638766, 20.06.2003; 4: 80, 60, 70, 50, E, 5, 1, 579224, 4634994, 24.06.2004; 5: 80, 60, 90, 30, W, 5, 2, 582746, 4627873, 24.06.2004; 6: 80, 50, 40, 30, SE, 5, 1, 581420, 4639003, 25.06.2004; 7: 50, 80, 90, 50, SE, 5, 1, 581751, 4638824, 22.06.2003; 8: 50, 60, 80, 60, E, 5, 1, 579196, 4635167, 22.06.2003; 9: 100, 50, 40, 80, E, 10, 1, 578894, 4639979, 23.06.2003; 10: 100, 30, 70, 50, E, 10, 1, 580580, 4639875, 23.06.2003; 11: 100, 30, 50, 40, E, 5, 1, 580034, 4639315, 21.06.2003; 12: 70, 50, 90, 20, E, 10, 1, 579382, 4639679, 22.06.2004; 13: 70, 70, 80, 5, SE, 10, 1, 580059, 4640236, 26.06.2004; 14: 80, 80, 80, 20, SE, 5, 1, 580627, 4639433, 21.06.2003; 15: 100, 10, 40, 80, E, 50, 18, 578954, 4632026, 26.06.2004; 16: 90, 10, 30, 80, SE, 45, 10, 578459, 4632302, 26.06.2005; 17: 90, 5, 40, 30, N, 35, 5, 580087, 4632271, 28.06.2005; 18: 90, 15, 20, 90, N, 55, 14, 582102, 4627169, 01.07.2005; 19: 80, -, 30 , 90, NW , 40, 5, 579799, 4633868, 27.06.2005; 20: 100, 20, 40, 80, NE, 70, 8, 578494, 4633259, 28.06.2005; 21: 80, -, 30, 80, N, 45, 12, 578448, 4633725, 03.07.2005; 22: 90, 3, 40, 80, SE, 30, 2, 579352, 4638610, 04.07.2005; 23: 90, 1, 30, 90, NE, 40, 10, 579410, 4639214, 01.07.2005; 24: 80, 2, 30, 80, NE, 45, 10, 577493, 4631357, 03.07.2005; 25: 90, 20, 50, 50, SE, 40, 18, 578404, 4632694, 04.07.2005; 26: 60, 2, 70, 90, W, 50, 2, 578681, 4638270, 10.07.2005; 27: 80, 20, 30, 90, E, 15, 5, 580410, 4633020, 26.06.2005; 28: 80, 3, 8, 80, N, 20, 26, 580793, 4633820, 11.07.2005; 29: 90, 8, 20, 90, NW, 50, 3, 578600, 4639163, 10.07.2005; 30: 80, 7, 30, 90, SE, 55, 7, 578138, 4638386, 11.07.2005; 31: 100, -, 50, 30, W, 40, 5, 580822, 4631322, 10.07.2005; 32: 100, 40, 30, 90, S, 10, 1, 579735, 4638017, 27.06.2005; 33: 95, 40, 40, 70, S, 10, 1, 578754, 4637220, 10.07.2005; 34: 80, 80, 20, 10, W, 55, 18, 581117, 4626875, 29.06.2005; 35: 100, 50, 5, 5, N, 45, 7, 580435, 4627646, 29.06.2005; 36: 100, 60, 30, 70, N, 25, 10, 577823, 4635318, 02.07.2005; 37: 70, 80, 30, 10, N, 50, 10, 579383, 4634386, 02.07.2005; 38: 100, 90, 50, 10, E, 5, 6, 580016, 4630614, 28.06.2005; 39: 90, 80, 70, 10, E, 65, 3, 580360, 4630898, 26.06.2005; 40: 80, 80, 80, 10, SE, 45, 9, 578182, 4634962, 05.07.2004; 41: 100, 5, 80, 30, SE, 55, 5, 580298, 4631690, 05.07.2004; 42: 100, 70, 50, 20, S, 30, 5, 579503, 4630643, 06.07.2004; 43: 80, 80, 70, 40, SW, 25, 5, 578417, 4631067, 05.07.2004; 44: 70, 70, 90, 1, N, 10, 5, 582078, 4627942, 05.07.2004; 45: 70, 80, 90, 3, E, 60, 9, 579609, 4632169, 11.07.2005; 46: 100, 60, 20, 30, N, 35, 4, 581758, 4627541, 06.07.2004; 47: 90, 5, 5, 90, SE, 15, 3, 579381, 4636301, 06.07.2004; 48: 80, 3, 2, 60, SE, 15, 10, 580576, 4636186, 07.07.2004; 49: 90, 5, 2, 60, SW, 12, 4, 579828, 4636345, 09.07.2004; 50: 80, 1, 10, 50, SE, 18, 8, 580318, 4636533, 27.06.2006; 51: 80, -, 1, 80, SW, 15, 9, 580910, 4636245, 08.07.2004; 52: 80, 2, 20, 90, E, 20, 7, 579767, 4637049, 28.06.2006; 53: 80, -, 10, 100, SW, 35, 3, 578155, 4637783, 07.07.2004; 54: 90, 3, 40, 100, NE, 5, 3, 578340, 4636878, 08.07.2004; 55: 100, -, 30, 90, SW, 10, 3, 579135, 4636757, 27.06.2006; 56: 80, 50, 30, 90, SE, 20, 3, 580360, 4630898, 28.06.2006; 57: 90, 5, 30, 90, S, 20, 3, 579088, 4637673, 28.06.2006; 58: 80, 10, 40, 60, NW, 50, 2, 578142, 4631663, 27.06.2006; 59: 90, 5, 30, 100, NE, 65, 4, 579552, 4632540, 28.06.2006; 60: 80, 20, 30, 100, S, 40, 8, 580358, 4633614, 07.07.2004; 61: 100, 10, 30, 60, E, 20, 19, 581330, 4631757, 09.07.2004; 62: 70, 5, 10, 80, S, 40, 25, 579076,4634563, 08.07.2004.

ДИВЕРЗИТЕТ И ЕКОЛОШКА ДИФЕРЕНЦИЈАЦИЈА ХРАСТОВИХ ШУМА У СЗ ТРАКИЈИ (ТУРСКА)

ALI KAVGACI[1], ANDRAŽ ČARNI[2], BARIŞ TECIMENI[3], GÜLEN ÖZALP[4]

[1]*Southwest Anatolia Forest Research Institute,* PK 264 07002 Antalya, Turkey
[2]*Institute of Biology, Scientific Research Center of Slovenian Academy of Sciences and Arts,* 1000 Ljubljana, Slovenia
[3]*Department of Soil Science and Ecology of Forestry, Faculty of Istanbul University,* 34495 Bahçeköy, Istanbul, Turkey
[4]*Department of Silviculture of Forestry, Faculty of Istanbul University,* 34495 Bahçeköy, Istanbul, Turkey

У овом раду упоређиване су , елабориране и класифициране доминантне храстове шуме са *Quercus robur*, *Q. frainetto*, *Q. cerris* и *Q. petraea* у Тракији (СЗ Турска), која претставља мост између Балкана и Анатолије. Еколошки услови процењивани су преко биоиндикаторских вредности. Храстове шуме могу се поделити у 4 групе: *Q. robur-Fraxinus angustifolia* шуме расту на поплавним равницама, *Q. petraea* шуме налазе се на већим надморским висинама, *Q. frainetto-Carpinus orientalis* шуме појављују се на најтоплијим и најсувљим стаништима, док *Q. frainetto* шуме на влажнијим стаништима . Установљено је да је најважнији топографски фактор надморска висина, док инклинација и аспекат имају мању важност.