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A phytosociological analysis of the *Quercus coccifera* L. stands in south Albania (NE Mediterranean)

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Keywords: Phytosociology, syntaxonomy, *Quercus coccifera*, *Quercetea ilicis*, eastern Adriatic, Ionian coast.

Ključne besede: fitosociologija, sintaksonomija, *Quercus coccifera*, *Quercetea ilicis*, vzhodni Jadran, ionska obala.

Abstract

The results of a phytosociological investigation of the *Quercus coccifera* L. stands occurring along the Adriatic and Ionian coasts in south Albania are given. The surveyed stands are localized in the Thermo-Mediterranean and Meso-Mediterranean belts. On the basis of literature and unpublished data, *Q. coccifera* stands extend from the shoreline up to 680 m of altitude, within the *Quercetea ilicis* vegetation zone. According to numerical analysis, *Q. coccifera* stands in south Albania can be divided into two broad groups forming macchia of 3–4 m height and low shrublands [0.5–1.5(-2) m)] defined primarily by degree of human pressure and altitudes. In addition, relevés from *Q. coccifera* stands in Albania were differentiated from Croatian and Montenegrin the *Fraxino orni-Quercetum cocciferae* associations. Conversely, *Q. coccifera* stands in south Albania share several biological and ecological similarities with those of the eastern Adriatic coast: hemicryptophytes prevailed and the chorological spectrum highlights a clear dominance of the steno-Mediterraneans. With respect to indicator values, an important differentiation from the eastern Adriatic associations was shown only in higher light intensity of the stands in Albania.

Izvleček

Predstavili smo rezultate fitocenološke raziskave sestojev vrste *Quercus coccifera* L. ob jadranski in ionski obali v južni Albaniji. Preučevani sestoji se pojavljajo v termo-mediteranskem in mezo-mediteranskem pasu. Na osnovi literaturnih in neobjavljenih podatkov smo ugotovili, da so sestoji *Q. coccifera* razširjeni od obale do višine 680 m v vegetacijski coni *Quercetea ilicis*. Z numerično analizo smo sestoje razdelili v dve široki skupini: 3–4 m visoko makijo in nizko grmičevje [0,5–1,5(-2) m)], ki ju opredeljuje predvsem stopnja človekovega vpliva in nadmorska višina. Popisi sestojev z *Q. coccifera* iz Albanije se jasno razlikujejo od asociacije *Fraxino orni-Quercetum cocciferae* iz Hrvaške in Črne Gore. Nasprotno pa so sestoji *Q. coccifera* iz južne Albanije po bioloških in ekoloških lastnostih podobni tistim z vzhodne jadranske obale: prevladujejo hemikriptofiti, horološki spekter pa kaže močno prevlado stenomediteranskih vrst. Indikatorske vrednosti pa ločujejo sestoje iz Albanije od vzhodnojadranskih le po večji potrebi po svetlobi.

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Introduction

Among the main forest species in Albania, oaks (*Quercus*) are represented by 12 taxa and their forests contribute to 32.7% of the surface area of Albania (Vangjeli & Habili 1995, Proko et al. 2005, Haska 2011). They are distributed over almost all the Albanian territory, but most of the forests occur in the north-east and south-eastern parts of Albania (Dida 2003). By contrast, Mediterranean shrubby formations were mainly found in the southern mountain region and mostly consisted of evergreen (e.g. *Quercus ilex*, *Q. coccifera*, etc.) or deciduous shrubs (*Paliurus spina-christi*, *Ulmus foliacea*, etc.) (Demiraj et al. 1996).

Generally, on the eastern Adriatic coast, the area of *Q. coccifera* L. distribution extends from the northern Croatian island of Mali Lošinj (44°35' N) to the south Albanian island of Sazani (40°29' N). It also occurs in the most south-western part of the Adriatic Basin in the Italian region of Puglia (Salento area), while its populations also continue on the Ionian coasts of both Italy (Basilicata region) and south Albania (districts of Vlorë and Sarandë) (Conti et al. 2005, Shuka 2010, Barina & Pifkó 2011, Miho et al. 2013, etc.).

The phytosociology of *Q. coccifera*-dominated vegetation formations has been studied across the Mediterranean region and many different associations and/or subassociations have been described (Tsiourlis et al. 2009, and references therein). The most recent and a very comprehensive description of *Q. coccifera* stands and their character-species on the eastern Adriatic, especially in Croatia, was given by Jasprica et al. (2015). On the eastern Adriatic, *Q. coccifera* forms a macchia (*Fraxino orni-Quercion ilicis*) within the *Fraxino orni-Quercetum cocciferae pistacietosum lentisci* in Croatia and Montenegro and also, though only sparsely, as shrubland within *Fraxino orni-Quercetum cocciferae nerietosum oleandri* subassociation in south Croatia. In addition, *Q. coccifera* also appears as a macchia within the *Erico arboreae-Arbutetum unedonis* (*Oleo sylvestris-Ceratonion siliquae*) association on the south Croatian island of Mljet.

In Albania, stands with *Q. coccifera* have been previously associated with the *Fraxino orni-Quercetum cocciferae* association (Hoda & Mersinllari 1996, Dring et al. 2002), but it seems that this association, at least in part, is not developed in the area (Jasprica et al. 2015).

Until now, very scarce data on the floristic composition and syntaxonomic characteristics of *Q. coccifera* stands from Albania have been available (Hoda & Mersinllari 1996). This study is focused on the known sites with *Q. coccifera* stands in south Albania. The objectives were: 1) to bring together the available published and recently collected data, and 2) to investigate the phytosociology and syntaxonomy of *Q. coccifera*-dominated formations in this area. The results will contribute to the scarce syntaxonomic knowledge of these formations within the *Quercetea ilicis* vegetation zone in Albania.

Study area

The study area of *Quercus coccifera*-stands covers most of the south Adriatic coast, extending from the Strait of Otranto where it connects to the Ionian Sea (Figure 1). The investigated area stretches along the district of Vlorë (AL: Rrethi i Vlorës; 40° 21' N, 19° 37' E; surface area of 1,609 km²; population of 151,314 estimated 2010) in the direction NW-SE.

The investigated area belongs to the Sazani and Ionian zones of External Albanides, and consists mostly of: i) Cretaceous fissured and karstified limestones, dolomitic limestones and dolostones (the Sazani-Karaburuni nature reserve, village of Dhërmi); ii) Quaternary gravel, sand and poorly consolidated boulders covered by shallow clay (village of Dukati), and iii) Neogenic rocks, mainly claystones, silts and marlstones (town of Orikumi) (Polemio et al. 2008, Frasheri et al. 2009). In terms of soils, Eurilithic Leptosol and Calcic Luvisol have developed in the investigated area (Zdruli 2005).

Phytogeographically, the area lies within the *Quercetea ilicis* vegetation zone, where the climate is typically Mediterranean: mild and rainy winters, warm and dry summers, and an extended period of sunshine throughout the year. Average annual air temperature is 16.5 °C and precipitation averages 1,028 mm yr^{-1} (Kabo 1990–1991, Nuri 1995, Frasheri et al. 2008). The highest daily average tem-

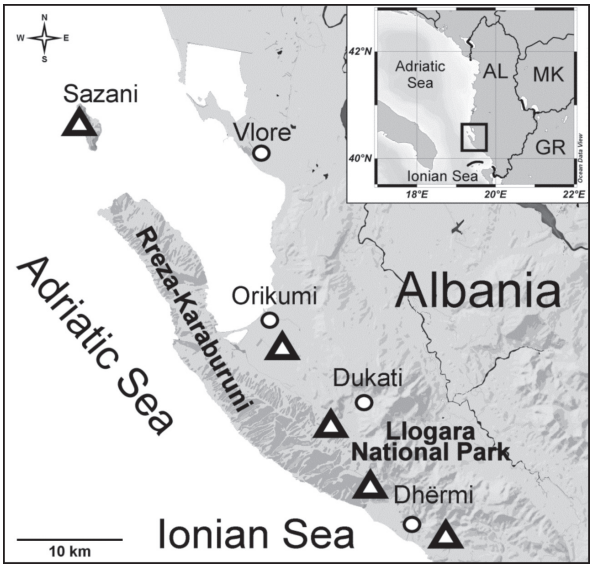

Figure 1: Position of investigated localities in south Albania. Abbreviations: AL - Albania, MK - Republic of Macedonia, GR - Greece.

Slika 1: Raziskovane lokacije v južni Albaniji. Okrajšave: AL - Albanija, MK - Republika Makedonija, GR - Grčija.

perature is 24.6 °C in August, and lowest falls below 9.2 °C in January. The absolute minimum recorded so far is -7 °C, but temperatures of zero or below occur only on 3 to 5 days per year. The highest temperature recorded during the past three decades is 39.5 °C. Eastern and south-eastern winds prevail in the area. The annual hours of sunshine are 2,734 (Nuri 1995). According to Köppen's climate classification, the coastal lowlands of Albania lie within the Csa climate zone (Köppen & Geiger 1954, Sträßer 1998).

Over the last decades the few remnants of natural vegetation, including *Q. coccifera* stands, in the Albanian karstic area have been seriously threatened by uncontrolled human activities (cf. Parise et al. 2004).

Material and Methods

Stands and relevé data

In this study, 35 phytocoenological relevés were analysed. In July 2014, 24 phytocoenological relevés were made on the Adriatic side of south-west Albania: 1) near the town of Orikumi, 2) SW of the village of Dukati within the Sazani-Karaburuni nature reserve, and on the Ionian coast, 3) on the S-facing slopes of Llogara Pass (AL: Qafa e Llogorasë), and 4) SE of the village of Dhërmi. The sampling localities are shown in Figure 1 (see also details on the sites of relevés in the Appendix). In addition, nine relevés from *Q. coccifera* shrublands in south Albania originating from the island of Sazani were used from Hoda and Mersinllari (1996).

Relevés were collected using the Braun-Blanquet (1964) approach. Most of the plot-sizes were set at 100 m², and every effort was made to achieve high ecological and physiognomic homogeneity within each plot (Moravec et al. 1994). The plots were located at various altitudes, exposures and inclinations. The system of characterizing species and the nomenclature of higher taxa were derived from Horvat et al. (1974), Rivas-Martínez et al. (2002) and Biondi et al. (2014). The nomenclature of plant species follows the Flora Europaea (Tutin et al. 1964–1980, 1993; Royal Botanic Garden Edinburgh 2014), except for *Cistus creticus* ssp. *eriocephalus* (marked with asterisks *) where the Med-Checklist was used (Greuter et al. 1984). Constant species were defined as those with a frequency > 30% in all the relevés. Dominant species were defined as those occurring in at least 10% of relevés of a vegetation unit with a cover value >25%. Biological form was verified in the field and denoted according to categories reported in Pignatti (1982), these being based on the classification of Raunkiaer (1934). Regarding chorological form, reference was also made to Jasprica et al. (2014, 2015), as well as to the monographs used for taxonomic nomenclature. The abbreviations of life- and chorological forms are given in Table 1, before the each species name. These abbreviations are denoted in Figure 3 and Table 2, respectively.

Regarding taxonomy, both *Q. coccifera* and *Q. calliprinos* Webb were reported from Albania (cf. Paparisto et al. 1988, Mullaj et al. 2010, Ball 2011). In this study, we recognize one taxon that is referred to as *Q. coccifera* and includes the possible presence of *Q. calliprinos*. In practice we accepted the taxonomic data in Euro+Med Plantbase (Euro+Med 2006-) and the results of Toumi and Lumaret (2010) who suggest that *Q. coccifera* and *Q. calliprinos* are, in fact, two morphotypes closely related genetically and constitute two components of the same species.

Statistical analysis

In order to obtain more complete information about *Q. coccifera* stands in south Albania, we compared our relevés with those from the eastern Adriatic coast (Jasprica et al. 2015). To identify vegetation types, relevés were classified by TWINSPAN (Hill 1979) using Juice 7.0 software (Tichý 2002). TWINSPAN pseudospecies cut levels for species abundances were set to 0–5–25 percentage scale units. Initially, six division levels were chosen. Later, different levels of division were accepted resulting in nine groups interpretable in terms of ecology.

The resulting classification were projected onto an ordination diagram using non-metric multidimensional scaling (NMDS) performed on a matrix of Bray-Curtis dissimilarities. Ordination was calculated using the R program (R Development Core Team 2012) and its vegan package (Oksanen et al. 2012).

For further interpretation of the ecological conditions of the studied vegetation types, unweighted average indicator values were used (Pignatti 2005) calculated in the JUICE 7.0. Average indicator values were presented with Box-Whiskers diagrams made in the STATISTICA 7.1 (STATSOFT inc. 2005).

Results

In this study, the *Quercus coccifera* stands in south Albania belong to the macchia or degraded scrub vegetation occurring in Mediterranean bioclimatic strata at 0–685 m a.s.l. (Table 1). *Q. coccifera* was also found at higher altitudes on the Llogara Pass (ca. 970 m a.s.l.) within the grassland vegetation not studied here. Generally, two groups of stands were recognized. The stands represent low [0.5–1.5(-2) m)] shrubby formations (the island of Sazani, Dukati and the S-facing slopes of Llogara Pass) or macchia of 3–4 m height (Orukumi, Dhërmi). They generally occupy slopes of 20–40° with vegetation cover from 30 to 100%. The habitats are exposed to disturbances.

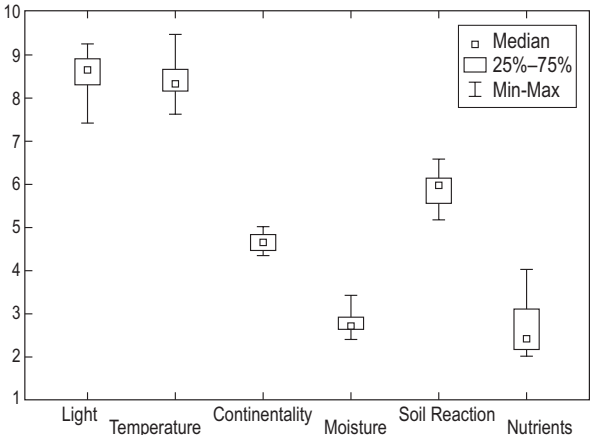

Figure 2: Pignatti indicator values in the *Quercus coccifera* stands in south Albania.

Slika 2: Pignattijeve indikatorske vrednosti sestojev *Quercus coccifera* v južni Albaniji.

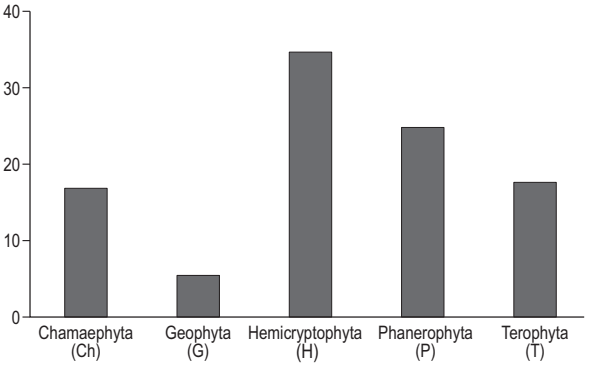

Figure 3: Life-form spectra (in percentage) in the *Quercus coccifera* stands in south Albania.

Slika 3: Spekter življenskih oblik (v odstotkih) v sestojih *Quercus coccifera* v južni Albaniji.

The stands had from 8 to 30 plant taxa (average 17.4). Generally the highest number of taxa was recorded on the island of Sazani. Constant species were: *Quercus coccifera*, *Pistacia lentiscus*, *Olea europaea* var. *sylvestris*, *Spartium junceum*, *Brachypodium retusum*, *Carlina corymbosa*, *Hyparrhenia hirta*, *Micromeria graeca*, *Phlomis fruticosa*, *Thymus capitatus*, *Erica manipuliflora*, *Teucrium polium*, *Scutellaria rubicunda* and *Scolymus hispanicus*. Dominant species were: *Quercus coccifera*, *Pistacia lentiscus*, *Phillyrea angustifolia*, *Phlomis fruticosa*, *Erica manipuliflora* and *Cistus creticus* ssp. *eriocephalus*.

The greatest number of characteristic species were found within the *Festuco valesiacae-Brometea erecti* (28), followed by the *Quercetea ilicis* and *Thero-Brachypodietea ramosi* (with 20 taxa in each class), *Artemisietea vulgaris* (13) and *Cisto cretici-Micromerietea julianae* (including *Erico-Cistetea*, 10 taxa). In addition to *Q. coccifera*, four other species displayed the greatest (>50%) presence: *Pistacia lentiscus*, *Brachypodium retusum*, *Phlomis fruticosa* and *Thymus capitatus*.

Quercus coccifera stands in south Albania showed high Pignatti indicator values for light intensity and temperature (Figure 2). On the other hand, low moisture and nutrient values were indicated. With regard to continentality and substrate reaction, the stands had an intermediate position.

The analysis of plant life forms showed that the stands were dominated by hemicryptophytes (35%) followed by phanerophytes (25%), while chamaephytes and therophytes contributed equally (17%) (Figure 3). Mediterranean floral elements (61%), mostly circum-Mediterranean plants (38.21%), followed by a considerable proportion of Eurasian plants (9.76%), dominated in the stands (Table 2).

Based on TWINSPAN, there was a clear difference in the structure between Croatian and Montenegrin associations (the mostly common subassociation *Fraxino orni-Quercetum cocciferae pistacietosum lentisci*) and stands in south Albania (Figure 4). In addition, stands in Albania also differed among the investigated localities.

In fact, relevés from the island of Sazani were separated into two groups (4 and 5). Group 5 (corresponding to the relevés 19–21, Table 1) was dominated by *Quercus ilex* and *Phillyrea angustifolia* while *Quercus coccifera* had low abundances. Relevés from Dukati and Llogara (groups 7 and 8), and only partly those from the island of Sazani (group 4), were closely related (Figure 4). Relevés from Dukati and Llogara were characterized by the absence of almost all taxa (except *Pistacia lentiscus* and *Juniperus oxycedrus* ssp. *macrocarpa*) from the *Quercetea*

Table 2: Floral elements in the *Quercus coccifera* stands in south Albania.
Tabela 2: Florni elementi vegetacije s *Quercus coccifera* v južni Albaniji.

Floral elements	No.	%
Circum-Mediterranean (CME)	47	38.21
East Mediterranean (EME)	12	9.76
Northeast Mediterranean (NEME)	3	2.44
Southeast Mediterranean (SEME)	12	9.76
South Mediterranean (SME)	1	0.81
West Mediterranean (WME)	1	0.81
Illyrian-Adriatic (IL-ADR)	7	5.69
Illyrian-Apennine (IL-APEN)	2	1.63
Illyrian-Balkanic (IL-BALK)	1	0.81
Mediterranean-Atlantic (MEAT)	6	4.88
Mediterranean-Pontic (MEPO)	2	1.63
European-Mediterranean (EURME)	1	0.81
Euroasian (EURAS)	12	9.76
Southeast European (SEE)	3	2.44
South European-Pontic (SEPO)	5	4.07
Cosmopolitan (WS)	8	6.50

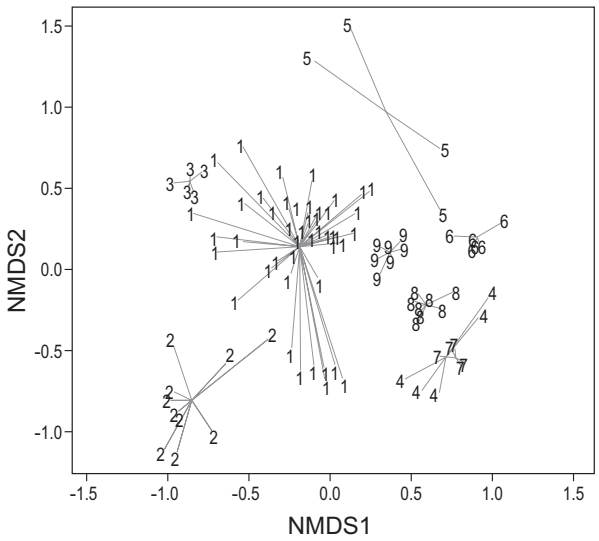

Figure 4: NMDS ordination diagram with projected cluster membership of the relevés. Group abbreviations: 1. *Fraxino orni-Quercetum cocciferae pistacietosum lentisci* (Croatia, Montenegro); 2. *Fraxino orni-Quercetum cocciferae nerietosum oleandri* (Croatia); 3. *Erico arboreae-Arbutetum unedonis* (Croatia); Stands in south Albania: Groups 4–5. Island of Sazani (rel. 14–22, Tab. 1); 6. Orikumi (rel. 8–13, Tab. 1); 7. Dukati (rel. 23–27, Tab. 1); 8. Llogara (rel. 28-35, Tab. 1); 9. Dhërmi (rel. 1–7, Tab. 1).

Slika 4: Ordinacijski diagram NMDS s prikazano pripadnostjo popisov posameznim klastrom. Okrajšave skupin: 1. *Fraxino orni-Quercetum cocciferae pistacietosum lentisci* (Hrvaška, Črna Gora); 2. *Fraxino orni-Quercetum cocciferae nerietosum oleandri* (Hrvaška); 3. *Erico arboreae-Arbutetum unedonis* (Hrvaška); sestoji iz Albanije: Skupini 4–5. otok Sazani (rel. 14–22, Tab. 1); 6. Orikumi (rel. 8–13, Tab. 1); 7. Dukati (rel. 23–27, Tab. 1); 8. Llogara (rel. 28-35, Tab. 1); 9. Dhërmi (rel. 1–7, Tab. 1).

ilicis class, and the presence of some common taxa from the *Thero-Brachypodietea ramosi* (e.g. *Brachypodium retusum*), *Festuco valesiacae-Brometea erecti* (*Teucrium polium*, *Bromus erectus* ssp. *condensatus*, etc.), and *Cisto cretici-Micromerietea julianae* (*Phlomis fruticosa*) classes. Relevés from Orikumi (group 6) and Dhërmi (group 9) showed some similarities due to the presence of the *Quercetea ilicis* taxa, particularly of *Spartium junceum* and *Olea europaea* var. *sylvestris*. Among all localities, relevés from Dhërmi were floristically the most closely related to Croatian and Montenegrin associations (group 1). Indeed, the similar physiognomic aspects of the stands were also evident.

Discussion

This study revealed the presence of sclerophyllous *Quercus coccifera* stands forming macchia or shrublands on the Adriatic and Ionian coasts of south Albania. Our results suggest that *Q. coccifera* stands in south Albania appear within the Thermo- and Meso-Mediterranean belts and extend from the shoreline up to 680 m of altitude within the *Quercetea ilicis* vegetation zone, the natural growing zone of *Q. coccifera*. In northern Greece, *Q. coccifera* formations were found from Meso-Mediterranean levels up to montane levels, and comprise at least two classes being syntaxonomically involved, i.e., *Quercetea ilicis* and *Quercetea pubescentis* (Mavrommatis 1980, Raus 1980, 1982, Bergmeier 1990, Bergmeier & Dimopoulos 2008). It has also been documented that *Q. coccifera* penetrates deep in the continental parts of Greece that are influenced by sub-Mediterranean climate, and can be found even within the vegetation of the *Rhamno catharticae-Prunetea spinosae* class (Tsiaoussi 1996). Further, in south Albania, *Q. coccifera* stands have already been found from 400–600 m a.s.l. in the nearby Llogara National Park – an area not included in our survey (Proko 1997).

The numerical analysis suggests that the relevés collected in south Albania, except partly for those made in Dhërmi, were distinct from the Croatian and Montenegrin *Fraxino orni-Quercetum cocciferae* associations. However, the floristic composition of the *Q. coccifera* macchia in south Albania does not include the characteristic shrub (*Fraxinus ornus*), and some climbing species of *Fraxino orni-Quercion ilicis*, such as *Rosa sempervirens*, *Lonicera implexa*, *L. etrusca*, and *Erica arborea*, *Viburnum tinus*, *Arbutus unedo*, etc., commonly presented along the eastern Adriatic coast and islands (Jasprica et al. 2015). In addition, *Q. coccifera* stands in south Albania were mostly depleted of *Quercus ilex* – the taxon frequently found in maquis communities and sclerophyllous woodlands in Central Albania (Kalajnxhiu et al. 2012). This led us to suggest that i) *Q. coccifera* stands should not be reffered to the *Fraxino orni-Quercetum cocciferae* association, as has been previously reported by Albanian authors (cf. Hoda & Mersinllari 1996, Ruci et al. 2001, Dring et al. 2002, Anonymous 2004), or ii) the stands can be even considered as degraded forms of the *Fraxino orni-Quercetum cocciferae* association. In our opinion, *Q. coccifera* stands in south Albania show some floristic and ecological similarities with the *Phillyreo latifoliae-Quercetum calliprini* association, described within the Thermo-Mediterranean bioclimatic belt on the Ionian island of Cephalonia (Bolòs et al. 1996). However, Greek association included the high presence of *Cyclamen hederifolium*, *Arisarum vulagre* and some others, and the majority of the typical Mediterranean evergreen shrubs, mainly the mesophilous species (*Arbutus unedo*, *A. andrachne*, etc.), not observed in our study probably as a result of combined types of human impact (cutting, grazing, wildfires). In either case, the *Q. coccifera* stands of south Albania, as in Greece, can be considered as degraded forms of the primary forests with *Q. coccifera* accompanied by *Q. ilex*, which currently

has only limited local distribution (Anonymous 2004, Tsiourlis et al. 2009). However, the dynamic potential of these stands, especially the temporal process of progressive succession and the corresponding climax forest community, are to a great extent site-dependent and are still not understood in detail (Proko 2008).

In comparison with the synthetic table made by Jasprica et al. (2015) for the Mediterranean zone (*Quercetea ilicis*) of the eastern Adriatic, many differences in the floristic composition of our stands can be found. *Quercus coccifera* stands in Albania are constituted basically by some characteristic species of rocky scrubland plant communties (*Phlomis fruticosa*) and dry grasslands (*Brachypodium retusum*), which occurred at higher percentages, while some of the main sclerophyllous species such as *Phillyrea latifolia*, *Asparagus acutifolius*, *Juniperus oxycedrus* ssp. *oxycedrus*, etc., appeared at low frequencies. Among *Quercetea ilicis* taxa, only *Pistacia lentiscus* occurred at higher percentages. This is only partly consistent with the findings of Tsiourlis et al. (2009) who found that *Phillyrea latifolia* and *Pistacia lentiscus* are among the most common species in the *Q. coccifera* shrublands of Greece. In our study the presence of some characteristic species of the ruderal and weed vegetation (*Artemisietea vulgaris*, *Stellarietea mediae*) suggest that some of the localities (e.g. Orikumi) were linked to the close proximity of settlements, an environment highly affected by man.

Further and in general, from the standpoint of the floristic and ecological characterization, there were no differences in the average number of taxa per relevé, the life-form and chorological spectra between the eastern Adriatic *Fraxino orni-Quercetum cocciferae* (the mostly common subassociation *pistacietosum lentisci*) association and the stands in south Albania. Namely, hemicryptophytes prevailed and the chorological spectrum highlights a clear dominance of the steno-Mediterraneans. With respect to species' ecological requirements, an important differentiation from the eastern Adriatic associations was shown only in the light intensity. This can be explained by a greater herb layer coverage and a higher species richness of herbs in the stands in south Albania.

The results of the current study suggest that the *Q. coccifera* stands in south Albania can be divided into two broad groups: i) macchia of 3–4 m height (Orikumi, Dhërmi), and ii) mostly low shrublands in the other investigated south Albanian localities. First, this was defined by the degree of human pressure. In fact, south Albanian *Q. coccifera* shrublands have suffered dramatic changes under anthropogenic activities (deforestation and overgrazing) that have affected both their physiognomy as well as their floristic composition (Proko 2008). Second, the importance of altitude in determining the distribution and compostion of the communities could not be ignored. Namely, some relevés (no. 23–35) were made at higher altitudes (350–685 m a.s.l.), and they were characterized by absence of the *Quercetea ilics* taxa and presence many taxa of the *Festuco valesiacae-Brometea erecti* class. In this case, *Q. coccifera* shrublands can mediate with the *Carpinion orientalis* communities (e.g. *Phillyreo latifoliae-Carpinetum orientalis*), which has already been documented in Greece (Bergmeier & Dimopoulos 2008).

The highly anthropogenic distribution and composition of *Q. coccifera* shrublands within the study area, accompanied by differences in taxonomical concepts (cf. Karaer 2010), does not permit the provision of a precise syntaxonomical reference in terms of association. According to the results of Tsiourlis et al. (2009), human-induced degradation can cause differentiations in *Q. coccifera* shrublands allowing some elements of the neighbouring flora to participate in, and often alter, both the physiognomy and the floristic composition of the shrublands.

Many of the *Q. coccifera* dominated shrublands in the Mediterranean were classified under the *Quercetum coccciferae* association in its broader sense (e.g. Bolòs 1959, Oliver 2004). This classification is based mainly on physiognomic criteria of the stands and their important floristic variations were commonly avoided. But even if we accept this concept, *Q. coccifera* stands in south Albania, at least in part, had some similarity with the *Quercetum cocciferae brachypodietosum* identified by Wraber (1952) in southern France and by Curcó (1991) in Catalonia (Spain). Some of the localities with *Q. coccifera* stands in south Albania have not been covered by this study (e.g. the western slopes of the Karaburuni peninsula), and clearly further studies of the communities are required to increase the accuracy of predictions.

In summary, we believe that the most significant result of this paper lies in the information and quantitative data it provides about *Q. coccifera* vegetation in this part of the NE Mediterranean. Nevertheless, given the relatively small area studied, the results should be read and analysed in the context of the anthropogenic influences that are occurring as a generalized phenomenon throughout the Mediterranean basin.

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Appendix

Syntaxonomic units mentioned in the text and Table 1 (in alphabetical order):

Ammophiletea Braun-Blanquet & Tüxen *ex* Westhoff, Dijk & Passchier 1946
Artemisieta vulgaris Lohmeyer, Preising & Tüxen *ex* von Rochow 1951
Carpinion orientalis Horvat 1958
Asplenietea trichomanis (Braun-Blanquet *in* H.Meier & Braun-Blanquet 1934) Oberdorfer 1977
Cisto cretici-Micromerietea julianae Oberdorfer *ex* Horvatić 1958
Drypidetea spinosae Quézel 1964
Erico arboreae-Arbutetum unedonis Allier & Lacoste 1980
Erico-Cistetea Trinajstić 1985
Festuco valesiacae-Brometea erecti Braun-Blanquet & Tüxen *ex* Braun-Blanquet 1949
Fraxino orni-Quercetum cocciferae (Horvatić 1958) Trinajstić 1985
Fraxino orni-Quercetum cocciferae (Horvatić 1958) Trinajstić 1985 *nerietosum oleandri* Jasprica & Škvorc 2015
Fraxino orni-Quercetum cocciferae (Horvatić 1958) Trinajstić 1985 *pistacietosum lentisci* Jasprica & Škvorc 2015
Fraxino orni-Quercion ilicis Biondi, Casavecchia & Gigante *ex* Biondi, Casavecchia & Gigante in Biondi, Allegrezza, Casavecchia, Galdenzi, Gigante & Pesaresi 2013
Molinio-Arrhenatheretea Tüxen 1937
Nerio oleandri-Tamaricetea africanae Braun-Blanquet & O. Bolòs 1958
Oleo sylvestris-Ceratonion siliquae Braun-Blanquet *ex* Guinochet & Drouineau 1944
Paliuretea Trinjastić 1978
Phillyreo latifoliae-Carpinetum orientalis Bergmeier 2008
Phillyreo latifoliae-Quercetum calliprini Knapp 1965 *em.* Barbéro & Quézel 1976
Quercetea ilicis Braun-Blanquet 1947
Quercetea pubescentis Doing-Kraft *ex* Scamoni & Passarage 1959
Quercetum cocciferae Braun-Blanquet 1924
Quercetum cocciferae Braun-Blanquet 1924 *brachypodietosum* Braun-Blanquet 1935
Querco cocciferae-Pistacietum lentisci Braun-Blanquet, Font Quer, G. Braun-Blanquet, Frey, Jansen, & Moor 1935 nom. mut. propos. (art. 45) (addenda) [*Querco cocciferae-Lentiscetum* Braun-Blanquet, Font Quer, G. Braun-Blanquet, Frey, Jansen, & Moor 1935]
Querco roboris-Fagetea sylvaticae Braun-Blanquet & Vlieger *in* Vlieger 1937
Rhamno catharticae-Prunetea spinosae Rivas Goday & Borja *ex* Tüxen 1962
Saginetea maritimae Westhoff, Leeuwen & Adriani 1962
Salicetea purpureae Moor 1958
Stellarietea mediae Tüxen, W. Lohmeyer & Preising *ex* von Rochow 1951
Thero-Brachypodietea ramosi Braun-Blanquet 1947
Thlaspietea rotundifolii Braun-Blanquet 1948
Trifolio medii-Geranietea sanguinei Müller 1962

Table 1. Place and date of relevés:

Rel. 1-7: Village of Dhërmi, 26 July 2014; rel. 1: 40°08'10.52" N, 19°38'49.65" E; rel. 2: 40°08'14.55" N, 19°38'48.88" E; rel. 3: 40°08'12.16" N, 19°38'49.87" E; rel. 4: 40°08'10.70" N, 19°38'50.24" E; rel. 5: 40°08'07.92" N, 19°38'51.82" E; rel. 6: 40°08'07.55" N, 19°38'52.31" E; rel. 7: 40°08'08.73" N, 19°38'54.02" E; **Rel. 8-13**: Town of Orikumi, 25 July 2014; rel. 8: 40°17'35.33" N, 19°29'28.95" E; rel. 9: 40°17'37.52" N, 19°29'28.46" E; rel. 10: 40°17'38.56" N, 19°29'27.95" E; rel. 11: 40°17'39.92" N, 19°29'27.42" E; rel. 12: 40°17'42.40" N, 19°29'28.12" E; rel. 13: 40°17'40.02" N, 19°29'31.93" E; **Rel. 14-22**: The island of Sazani (40°29'09.84" N, 19°17'15.91" E), from Hoda & Mersinllari (1996); **Rel. 23-27**: Village of Dukati, 25 July 2014; rel. 23: 40°14'33.24" N, 19°33'01.23" E; rel. 24: 40°14'32.79" N, 19°33'00.06" E ; rel. 25: 40°14'31.59" N, 19°32'59.00" E; rel. 26: 40°14'34.22" N, 19°33'01.12" E; rel. 27: 40°14'33.25" N, 19°32'02.75" E; **Rel. 28-35**: Southern slopes bellow the Llogara Pass, 26 July 2014; rel. 28: 40°11'06.18" N, 19°35'35.79" E; rel. 29: 40°11'06.54" N, 19°35'36.46" E; rel. 30: 40°11'06.84" N, 19°35'36.68" E; rel. 31: 40°11'07.38" N, 19°35'40.90" E; rel. 32: 40°11'06.92" N, 19°35'41.77" E; rel. 33: 40°11'06.62" N, 19°35'42.14" E; rel. 34: 40°11'07.97" N, 19°35'40.55" E; rel. 35: 40°11'05.79" N, 19°35'36.81" E.

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Table 1: Vegetation of the *Quercus coccifera* stands in south Albania.
Tabela 1: Vegetacija z vrsto *Quercus coccifera* v južni Albaniji.

FE	LF	No of relevés	1	2	3	4	5	6	7	8	9	10	11
		No of group in Figure 4	9	9	9	9	9	9	9	6	6	6	6
		No of species	25	19	15	12	11	14	17	30	15	14	15
		Altitude (m)	5	5	15	20	16	19	38	66	64	64	65
		Slope (°)	40	40	40	40	40	40	40	10	10	10	10
		Aspect	S	SW	SW	S	S	S	S	NE	NE	NE	NE
		Vascular plant cover (%)	95	100	100	100	100	100	100	100	100	100	100
		Surface (m²)	100	100	100	100	100	100	100	50	50	50	100
		Height of vegetation (m)	4	4	4	4	4	4	4	4	3-4	3-4	3-4
		Char. Ass.											
P	CME	*Quercus coccifera* L. (incl. *Q. calliprinos* Webb)	5	5	5	5	5	5	5	3	5	4	5
		Quercetea ilicis											
		Oleo sylvestris-Ceratonion siliquae											
P	CME	*Pistacia lentiscus* L.	1	+	+	+	+	+	+	.	.	.	.
P	CME	*Olea europaea* L. var. *sylvestris* Brot.	1	+	+	+	+	+	+	+	+	+	+
P	CME	*Myrtus communis* L.	+	+	+	+	+	+	+	.	.	.	.
P	CME	*Juniperus oxycedrus* L. ssp. *macrocarpa* (Sibth. & Sm.) Ball	.	.	.	.	.	.	.	.	.	.	.
Ch	CME	*Prasium majus* L.	+	.	.	.	.	.	.	.	.	.	.
P	CME	*Calicotome villosa* (Poiret) Link	+	+	+	.	.	.	.	.	.	.	.
P	WME	*Phillyrea angustifolia* L.	.	.	.	.	.	.	.	.	.	.	.
		Fraxino orni-Quercion ilicis											
P	CME	*Spartium junceum* L.	1	+	+	+	+	+	+	2	1	1	1
P	CME	*Smilax aspera* L.	+	+	+	+	+	.	.	.	.	.	.
P	MEAT	*Rubus ulmifolius* Schott	.	.	.	.	.	.	.	+	+	+	+
G	CME	*Asparagus acutoflius* L.	.	.	.	+	.	.	.	+	+	.	.
P	CME	*Pistacia terebinthus* L.	.	.	.	.	.	.	1	.	.	.	.
P	CME	*Rubia peregrina* L.	.	.	.	.	.	.	.	.	.	.	.
P	EME	*Cupressus sempervirens* L. (juv.)	+	+	+	.	.	.	.	.	.	.	.
P	CME	*Juniperus oxycedrus* L. ssp. *oxycedrus*	+	.	+	.	.	+	.	.	.	.	.
P	CME	*Quercus ilex* L.	.	.	.	.	.	.	.	.	.	.	.
Ch	CME	*Teucrium flavum* L.	.	.	.	.	.	.	.	.	.	.	.
P	CME	*Clematis flammula* L.	.	.	.	.	.	.	.	+	+	.	.
P	CME	*Phillyrea latifolia* L.	.	.	.	.	.	.	+	.	.	.	.
H	EURAS	*Rubia tinctorum* L.	.	.	.	.	.	.	.	.	.	.	.
		Companions											
		Thero-Brachypodietea ramosi											
H	CME	*Brachypodium retusum* (Pers.) Beauv.	+	+	1	1	+	+	+	.	.	.	.
H	CME	*Carlina corymbosa* L.	.	.	.	.	.	.	.	+	+	+	+
H	CME	*Hyparrhenia hirta* (L.) Stapf	+	+	+	+	+	+	+	+	.	+	.
Ch	IL-ADR	*Micromeria graeca* (L.) Bentham ex Reichenb.	.	.	.	.	.	.	.	.	.	.	.
G	CME	*Asphodelus aestivus* Brot.	.	.	.	.	.	.	.	.	.	.	+
T	CME	*Pallenis spinosa* (L.) Cass.	.	.	.	.	.	.	.	+	.	.	.
T	MEAT	*Blackstonia perfoliata* (L.) Hudson	.	.	.	.	.	.	.	.	.	.	.
H	WS	*Centaurium erythraea* Rafn	+	.	.	.	.	.	.	.	.	.	.

12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
6	6	5	4	4	4	4	5	5	5	4	7	7	7	7	7	8	8	8	8	8	8	8	8	
15	23	11	20	25	24	19	8	20	20	28	21	19	12	13	14	20	17	16	17	17	13	15	15	
64	66	100	180	250	150	200	150	130	180	270	358	367	380	356	349	655	658	661	678	675	673	685	650	
10	10	30	25	25	30	30	25	25	35	25	20	20	20	20	20	30	30	30	30	30	30	30	30	
NE	NE	W	SW	WSW	S	W	SW	NW	W	SW	E	E	NW	NW	NW	W	W	W	W	W	W	W	W	Fr.
100	100	-	-	-	-	-	-	-	-	-	50	90	30	40	40	100	100	100	100	100	90	90	90	
100	100	-	-	-	-	-	-	-	-	-	100	100	100	100	100	100	100	100	100	100	100	100	100	
3-4	3-4	-	-	-	-	-	-	-	-	-	0.5	1-2	2	1.5	1.5	0.8	0.8	0.9	0.9	0.8	0.8	0.7	0.6	%
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FE	LF	No of relevés	1	2	3	4	5	6	7	8	9	10	11
T	IL-ADR	*Bupleurum baldense Turra* ssp. *gussonei* (Arcangeli) Tutin	.	.	.	.	.	.	.	.	.	.	.
H	SEME	*Piptatherum miliaceum* (L.) Cosson	+	.	.	.	.	+	.	.	.	.	+
H	CME	*Andropogon distachyos* L.	.	.	.	.	.	.	.	.	.	.	.
T	CME	*Brachypodium distachyon* (L.) Beauv.	.	.	.	.	.	.	.	.	.	.	.
G	SEME	*Allium sphaerocephalon* L.	.	.	.	.	.	.	.	.	.	.	.
T	WS	*Anagallis foemina* Miller	.	.	.	.	.	.	.	.	.	.	.
H	NEME	*Helictotrichon convolutum* (C.Presl) Henrard	.	.	.	.	.	.	.	.	.	.	.
G	CME	*Urginea maritima* (L.) Baker	.	.	.	.	.	.	.	.	.	.	.
T	SEPO	*Avena sterilis* L.	+	.	.	.	.	.	+	.	.	.	.
T	CME	*Briza maxima* L.	.	.	.	.	.	.	.	.	.	.	.
T	CME	*Lagurus ovatus* L.	.	.	.	.	.	.	.	.	.	.	.
H	IL-APEN	*Asyneuma limonifolium* (L.) Janchen	.	.	.	.	.	.	.	.	.	.	.
		Cisto cretici-Micromerietea julianae + Erico-Cistetea											
P	EME	*Phlomis fruticosa* L.	+	+	.	.	.	.	+	3	1	1	+
Ch	CME	*Thymus capitatus* (L.) Hoffmanns. & Link	+	+	+	+	+	+	+	1	1	+	+
Ch	EME	*Erica manipuliflora* Salisb.	1	+	+	+	+	+	+	.	.	.	.
P	EME	*Cistus creticus* L. ssp. *eriocephalus* (Viv.) Greuter & Burdet*	+	+	.	.	.	.	.	.	.	.	.
Ch	CME	*Dorycnium hirsutum* (L.) Ser.	.	.	.	.	.	.	.	.	.	.	.
Ch	CME	*Fumana scoparia* Pomel	.	.	.	.	.	.	.	.	.	.	.
Ch	CME	*Micromeria juliana* (L.) Bentham ex Reichenb.	.	.	.	.	.	.	.	.	.	.	.
Ch	CME	*Fumana thymifolia* (L.) Spach ex Webb	.	.	.	.	.	.	.	.	.	.	.
Ch	CME	*Anthyllis hermanniae* L.	.	.	.	.	.	.	.	.	.	.	.
P	EME	*Cistus salvifolius* L.	.	.	.	.	.	.	.	.	.	.	.
		Festuco valesiacae-Brometea erecti											
Ch	MEPO	*Teucrium polium* L.	.	.	.	.	.	.	.	.	.	.	.
H	SEME	*Bromus erectus* Huds. ssp. *condensatus* (Hack.) Asch. & Graebn.	.	.	.	.	.	.	.	.	.	.	.
Ch	SEE	*Thymus longicaulis* C. Presl aggr.	.	.	.	.	.	.	.	.	.	.	.
H	EURAS	*Melica ciliata* L.	.	.	.	.	.	.	.	.	.	.	.
Ch	EURAS	*Origanum vulgare* L.	.	.	.	.	.	+	+	.	.	.	.
H	SEME	*Petrorhagia saxifraga* (L.) Link	.	.	.	.	.	.	.	+	.	.	.
H	SEME	*Koeleria splendens* C. Presl	.	.	.	.	.	.	.	.	.	.	.
H	NEME	*Stachys cretica* L. ssp. *salviifolia* (Ten.) Rech. fil.	.	.	.	.	.	.	.	.	.	.	.
H	SEME	*Galium corrudifolium* Vill.	.	.	.	.	.	.	.	+	.	.	+
T	MEAT	*Desmazeria rigida* (L.) Tutin	.	.	.	.	.	.	.	.	.	.	.
H	IL-ADR	*Anthyllis x rubicunda* Wender.	.	.	.	.	.	.	.	.	.	.	.
T	SEME	*Bromus hordeaceus* L.	.	.	.	.	.	.	.	.	.	.	.
T	CME	*Echinaria capitata* (L.) Desf.	.	.	.	.	.	.	.	.	.	.	.
H	SEPO	*Centaurea salonitana* Vis.	.	.	.	.	.	.	.	+	.	.	.
Ch	IL-APEN	*Onosma echioides* L.	.	.	.	.	.	.	.	.	.	.	.
Ch	SEPO	*Teucrium chamaedrys* L.	.	.	.	.	.	.	.	.	.	.	.
H	EURAS	*Poa bulbosa* L.	.	.	.	.	.	.	.	.	.	.	.
H		*Festuca* sp.	.	.	.	.	.	.	.	.	.	.	.
Ch	EURME	*Ononis spinosa* L.	.	.	.	.	.	.	.	.	.	.	.
H	SEME	*Chondrilla juncea* L.	.	.	.	.	.	.	.	+	.	.	.
T	EME	*Petrorhagia prolifera* (L.) P.W. Ball & Heywood	.	.	.	.	.	.	.	.	.	.	.
H	SEE	*Dorycnium pentaphyllum* Scop. ssp. *pentaphyllum*	.	.	.	.	.	.	.	.	.	.	.
H	CME	*Asperula aristata* L.f. ssp. *scabra* (J.Presl & C.Presl) Nyman	.	.	.	.	.	.	.	.	.	.	.

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FE	LF	No of relevés	1	2	3	4	5	6	7	8	9	10	11
H	EURAS	*Phleum pratense* L. ssp. *bertolonii* (DC.) Bornm.	.	.	.	.	.	.	.	.	.	.	.
Ch	IL-ADR	*Genista pulchella* Vis. ssp. *pulchella*	+	+	.	.	.	.	.	.	.	.	.
Ch	EURAS	*Thymus pulegoides* L. aggr.	.	.	.	.	.	.	.	.	.	.	.
H	EURAS	*Scabiosa columbaria* L.	.	.	.	.	.	.	.	.	.	.	.
Ch	IL-ADR	*Salvia officinalis* L.	.	.	.	.	.	.	+	.	.	.	.
		Thlaspietea rotundifolii + Drypidetea spinosae											
H	EME	*Scutellaria rubicunda* Hornem.	.	.	.	.	.	.	.	.	.	.	.
Ch	IL-BALK	*Cerastium grandiflorum* Waldst. & Kit.	.	.	.	.	.	.	.	.	.	.	.
		Artemisietea vulgaris											
H	CME	*Scolymus hispanicus* L.	.	.	.	.	.	.	.	1	+	+	+
H	CME	*Verbascum sinuatum* L.	.	.	.	.	.	.	.	+	+	+	+
H	CME	*Dittrichia viscosa* (L.) W. Greuter	+	+	.	.	.	.	.	+	.	.	+
H	IL-ADR	*Daucus carota* L. ssp. *major* (Vis.) Arcangeli	.	.	.	.	.	.	.	+	+	+	+
T	MEAT	*Echium plantagineum* L.	+	.	.	.	.	.	.	+	.	.	.
H	CME	*Foeniculum vulagre* Mill.	.	.	.	.	.	.	.	+	.	.	.
T	MEPO	*Dasypyrum villosum* (L.) P. Candargy	.	.	.	.	.	.	.	+	.	.	.
H	WS	*Cichorium intybus* L.	.	.	.	.	.	.	.	.	.	.	.
H	MEAT	*Centaurea calcitrapa* L.	.	.	.	.	.	.	.	.	.	.	.
H	CME	*Picnomom acarna* (L.) Cass.	.	.	.	.	.	.	.	+	.	.	.
H	SEPO	*Eryngium campestre* L.	.	.	.	.	.	.	.	.	.	.	.
H	SEPO	*Centaurea solstitialis* L.	.	.	.	.	.	.	.	.	.	.	.
T	CME	*Sonchus asper* (L.) Hill	.	.	.	.	.	.	.	.	.	.	.
		Querco roboris-Fagetea sylvaticae											
P	EME	*Coronilla emerus* L. ssp. *emeroides* (Boiss. & Spruner) Hayek	+	1	+	+	+	+	+	.	.	.	.
G	WS	*Pteridium aquilinum* (L.) Kuhn	.	.	.	.	.	.	.	.	.	.	.
G	CME	*Cyclamen hederifolium* Aiton	.	.	.	.	.	.	.	.	.	.	.
P	SEE	*Lonicera caprifolium* L.	.	.	.	.	.	.	.	.	.	.	.
P	NEME	*Quercus trojana* Webb	.	.	.	.	.	+	.	.	.	.	.
P	EME	*Quercus macrolepis* Kotschy	.	.	.	.	.	.	+	.	.	.	.
		Asplenietea trichomanis											
P	SME	*Putoria calabrica* (L.f.) DC.	+	+	.	.	.	.	.	.	.	.	.
Ch	EME	*Inula verbascifolia* (Willd.) Hausskn.	+	+	+	.	.	.	.	.	.	.	.
P	CME	*Ficus carica* L.	.	.	.	.	.	.	.	.	+	+	.
H	SEME	*Ceterach officinarum* DC.	.	.	.	.	.	.	.	.	.	.	.
		Paliuretea											
P	EME	*Paliurus spina-christi* Miller	.	.	.	.	.	.	.	1	1	+	+
P	IL-ADR	*Rhamnus intermedius* Steudel & Hochst.	.	.	.	.	.	.	.	.	.	.	.
		Quercetea pubescentis+Rhamno-Prunetea											
P	SEME	*Pyrus amygdaliformis* Vill.	.	.	.	.	.	.	.	+	.	.	.
H	WS	*Clinopodium vulgare* L.	.	.	.	.	.	.	.	.	.	.	.
		Trifolio medii-Geranietea sanguinei											
H	EME	*Origanum heracleoticum* L.	.	.	.	.	.	.	.	.	+	.	.
		Stellarietea mediae											
T	EURAS	*Avena fatua* L.	.	.	.	.	.	.	.	.	.	.	.
T	EURAS	*Veronica arvensis* L.	.	.	.	.	.	.	.	+	.	+	.
T	WS	*Bromus sterilis* L.	.	.	.	.	.	.	.	.	.	.	.
T	WS	*Sisymbrium officinale* (L.) Scop.	.	.	.	.	.	.	.	+	.	.	.
T	CME	*Anthemis arvensis* L.	.	.	.	.	.	.	.	+	.	.	.

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FE	LF	No of relevés	1	2	3	4	5	6	7	8	9	10	11
T	CME	*Lathyrus cicera* L.	.	.	.	.	.	.	.	+	.	.	.
		Molinio-Arrhenatheretea											
H	EURAS	*Dactylis glomerata* L.	.	.	.	.	.	.	.	.	.	.	.
H	SEME	*Hypericum perforatum* L.	.	.	.	.	.	.	.	.	.	.	.
H	SEME	*Lotus corniculatus* L.	.	.	.	.	.	.	.	.	.	.	.
H	EURAS	*Anthoxanthum odoratum* L.	.	.	.	.	.	.	.	.	.	.	.
H	WS	*Plantago lanceolata* L.	.	.	.	.	.	.	.	.	.	.	.
		Nerio oleandri-Tamaricetea africanae											
P	CME	*Vitex agnus-castus* L.	+	+	.	.	.	.	.	.	.	.	.
		Ammophiletea											
G	CME	*Elymus pycnanthus* (Godr.) Melderis	+	.	.	.	.	.	.	.	.	.	.
		Salicetea purpureae											
P	EURAS	*Salix eleagnos* Scop.	.	.	.	.	.	.	.	+	.	.	.
		Saginetea maritimae											
T	MEAT	*Parapholis filiformis* (Roth) C.E.Hubbard	.	.	.	.	.	.	.	.	.	.	.

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