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VEGETATION SURVEY

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Classification of forest and shrubland vegetation in Mediterranean Turkey

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Abstract

Questions: What are the main vegetation types of forest and shrubland vegetation at the alliance level in Mediterranean Turkey? What is their syntaxonomical position? Can we integrate them into the European vegetation classification system? Which environmental factors are the main drivers of the floristic differentiation of vegetation types?

Location: Southern and western Turkey.

Methods: We collected 4,717 vegetation plots of forest and shrubland vegetation in Mediterranean Turkey and performed an unsupervised classification of this data set. We described vegetation types based on the classification results, expert knowledge and information from the literature. We defined diagnostic species and prepared distribution maps for each vegetation type. To support the interpretation of the vegetation types, we determined the most important environmental variables using canonical correspondence analysis.

Results: The studied vegetation was divided into 21 types related to three vegetation belts: (a) thermo- and meso-mediterranean, comprising coniferous (*Pinus brutia*, *Pinus pinea*) and sclerophyllous forests, as well as macchia, garrigue and phrygana; (b) supra-mediterranean, comprising *Pinus nigra* subsp. *pallasiana* forests, thermophilous deciduous forests dominated by various oak species and *Ostrya carpinifolia*, and forests dominated by temperate species such as *Fagus orientalis*; and (c) oro-mediterranean, comprising forests and shrublands dominated by *Abies cilicica*, *Cedrus libani*, *Juniperus excelsa* and *Juniperus communis* subsp. *nana*. Elevation was identified as the main environmental driver of the vegetation pattern. Among climatic variables, the most important are the mean temperatures (annual and of driest, coldest, and warmest quarters), minimum temperature of winter, precipitation of warmest and driest quarters and precipitation seasonality. These factors indicate the decreasing effect of the Mediterranean climate with increasing elevation.

Conclusions: The vegetation of Mediterranean Turkey is arranged along climatic gradients depending on elevation and the distance from the Mediterranean Sea. Most vegetation types in this area correspond to the syntaxa accepted in EuroVegChecklist, while others were described as new.

KEYWORDS
coniferous forest, deciduous forest, garrigue, macchia, Mediterranean, numerical analysis, phrygana, plant communities, shrubland, Turkey, vegetation-plot database, vegetation types

1 | INTRODUCTION

The Mediterranean Basin is one of the global biodiversity hotspots (Myers et al., 2000). Its vegetation is mainly dominated by broad-leaved and needle-leaved evergreen tree species, but deciduous trees are also well represented (Gauquelin et al., 2016). The knowledge on vegetation diversity varies across this area. The floristic and vegetation diversity of the European part of the Mediterranean Basin has been studied extensively (Mucina et al., 2016), whereas it is still insufficiently explored in the Asian and African parts, making it difficult to develop international conservation strategies.

The Mediterranean phytogeographical region in Turkey covers mainly the western (Aegean) and southern parts of Turkey, while northern Turkey belongs to the Euro-Siberian region and the central and eastern part of Turkey to the Irano-Turanian region (Davis, 1971). Southern Mediterranean Turkey with Cyprus is considered as one of ten biodiversity hotspots in the Mediterranean Basin (Médail & Quézel, 1999). Southern Mediterranean Turkey is the richest in endemism among all the Turkish regions (Noroozi et al., 2019). Like other parts of the Mediterranean Basin, Mediterranean Turkey comprises human-shaped ecosystems (Blondel, 2006), and it is additionally affected by climate change and related factors, especially the changing fire regime (Viedma et al., 2017). Understanding the vegetation diversity of Mediterranean Turkey has important implications for nature conservation and ecological restoration.

The first vegetation studies based on the Braun-Blanquet approach in Turkey were performed in the 1940s (Ekim & Akman, 1991). Research intensified during the 1960s and 1970s, especially in collaboration with the French researchers Pierre Quézel and Marcel Barbero (Akman et al., 1978, 1979a, 1979b). Since then, the number of phytosociological studies covering different parts of the country has increased and syntaxonomic checklists were prepared (Quézel et al., 1993; Ketenoğlu et al., 2010). The development of numerical techniques in vegetation science has also positively affected vegetation studies in Turkey. These techniques have been used intensively both in large-scale and regional phytosociological studies (Uğurlu et al., 2012; Çoban & Willner, 2019; Karaköse, 2019; Yildirim et al., 2019; Kenar et al., 2020).

Analysis of vegetation and habitat diversity crucially depends on the availability of vegetation-plot data (Dengler et al., 2011; Chytrý et al., 2016, 2020). Therefore, many countries have created their own national vegetation-plot databases over the last decades. The process of aggregation of these databases resulted in the creation of the integrated database European Vegetation Archive (EVA; Chytrý et al., 2016) and subsequently of the global database sPlot (Bruelheide et al., 2019), which are still growing. One of the national databases developed under these initiatives is the Forest Vegetation Database of Turkey (GIDV ID: 00-TR-001), which now includes more than 8,500 vegetation plots and aims at collecting all vegetation plots of forest and shrubland vegetation in Turkey (Kavgacı et al., 2012; Kavgacı & Čarni, 2012).

Vegetation plots from the Mediterranean phytogeographical region are the most abundant in the Forest Vegetation Database of Turkey. They represent vegetation across the whole of this region, being an invaluable resource for studying and understanding the floristic and vegetation diversity of Mediterranean Turkey.

The aims of this study are to: (a) define the main vegetation types of forests and shrublands in Mediterranean Turkey; (b) identify the main environmental variables affecting the diversity of this vegetation; and (c) assess the syntaxonomy of these vegetation types and integrate them into the European vegetation classification system (Mucina et al., 2016).

2 | METHODS

Our study area is Mediterranean Turkey as defined on the phytogeographical map of Davis (1971). However, we also included the Mediterranean vegetation appearing in inner Anatolia, representing the transition between the Mediterranean and Irano-Turanian phytogeographical regions. We first checked the Forest Vegetation Database of Turkey, which was stored in the TURBOVEG (2.149a) database management program (Hennekens & Schaminée, 2001), and entered missing published and unpublished vegetation plots from forests and shrublands of Mediterranean Turkey. All vegetation plots in the data set were sampled according to the Braun-Blanquet sampling method (Braun-Blanquet, 1964). The species taxonomy and nomenclature in the database was unified to follow the Flora of Turkey (Davis, 1965-1985; Davis et al., 1988; Güner et al., 2000; see Appendix S1 for the vegetation data sources).

For the analyses, we selected only vegetation plots containing a tree or shrub layer with a cover of at least 25%. The selection resulted in a total of 4,717 vegetation plots. All records of species represented also by various subspecies and varieties in the data set were merged to the species level. However, if a species was represented only by a single subspecies or variety in the data set, these infraspecific taxa were retained. We removed species identified to the genus or family level, cryptogams, vegetation plots from azonal vegetation (especially riparian vegetation dominated by *Alnus orientalis*, *Liquidambar orientalis* and *Platanus orientalis*), and vegetation plots with three or fewer species. Additionally, we merged species records from different layers into a single layer because this information was not consistently recorded among studies. As a result, the data set included 4,071 vegetation plots and 2,010 species. These data were used for the subsequent classification and ordination analyses. We used the JUICE 6.4 program (Tichý, 2002) for data set editing.

Before the numerical analyses, square-root transformation was applied to the percentage values of species cover. We used the Sørensen dissimilarity index as a resemblance measure and Beta Flexible clustering ($\beta = -0.25$) using the PC-ORD program (McCune & Mefford, 2006). Beta Flexible clustering is one of the most commonly used plot-grouping algorithms to define vegetation types at different hierarchical levels (De Cáceres et al., 2015). Vegetation types were based on the clustering results. The number of clusters representing the vegetation units was determined according to the dominant species of clusters conforming to vegetation types at the alliance level in Mediterranean Turkey. In some cases, we also integrated expert knowledge and information from the literature to divide some clusters into narrower types based on the physiognomic, biogeographical, and elevational differences. For the separation of these clusters, dominant species responsible for the contrasting vegetation structure and subgrouping of clusters for biogeographical and elevational differences were used. Vegetation plots were moved from one cluster to another only if these two clusters had contrasting vegetation structure (32 vegetation plots).

Diagnostic species of vegetation types were defined by calculating the fidelity of each species to each vegetation type (Chytrý et al., 2002) using the phi coefficient of association as fidelity measure. The species with a φ-value higher than 0.20 were considered as diagnostic. The phi coefficient was calculated for an equalized size of clusters (Tichý & Chytrý, 2006). Species with a cover of more than 25% in at least 10% of the vegetation plots in each type were considered as dominant species.

We used canonical correspondence analysis (CCA) with a Monte Carlo test with 999 unrestricted permutations to test the effects of environmental variables on the floristic composition of vegetation. Elevation and climatic data (from WorldClim 2; Fick & Hijmans, 2017) were used as environmental variables. We also assessed the gradients in species composition of the vegetation types using an indirect ordination method, detrended correspondence analysis (DCA). Both CCA and DCA are suitable to analyse heterogeneous species-by-plot matrices like ours because they assume unimodal response of species to the environment. The most significant environmental variables (according to CCA) were passively projected onto the DCA ordination space. Both CCA and DCA were computed using CANOCO 5 (Šmilauer & Lepš, 2014).

We followed the fourth edition of the International Code of Phytosociological Nomenclature (ICPN; Theurillat et al., 2021) for nomenclature and typification of syntaxa.

3 | RESULTS

3.1 | Hierarchical classification

A classification dendrogram of forests and shrublands in Mediterranean Turkey is shown in Figure 1. We accepted a division into 18 main clusters that correspond to the phytosociological alliances of forests and shrublands in Mediterranean Turkey. However, three of them were further divided into two types due to physiognomic (Cluster 2), biogeographical (Cluster 4) and elevational (Cluster 7) differences. Consequently, we obtained 21 vegetation types. The classification of Mediterranean forests and shrublands is presented in a synoptic table (Table 1 and Appendix S2), in which statistically determined diagnostic species are indicated and ranked by decreasing fidelity (phi coefficient). The distribution of each vegetation type is shown in Figure 2. Photos of typical stands of each vegetation type are provided in Figure 3.

Cluster 1 includes low, thorny and chamaephytic communities, namely phrygana. This vegetation type is dominated by *Sarcopoterium spinosum*. It is characterized by a high number of diagnostic species. Although these phrygana communities mainly appear in the Aegean region, they also occur in southern Turkey (Figure 2-1).

Cluster 2 is represented by garrigue communities dominated by *Cistus creticus* and *Genista acanthoclada*. However, *Pinus pinea* forests were also placed within this cluster due to their floristic similarities to garrigue despite an entirely different physiognomy. Since the physiognomic aspect should also be considered in classification, in addition to floristic features, we divided Cluster 2 into two groups. *Cistus creticus* and *Genista acanthoclada*-dominated garrigue is a xerophilous dwarf scrub distributed in lowlands throughout Mediterranean Turkey (Figure 2-2a). *Pinus pinea*-dominated forests are scattered throughout Mediterranean Turkey, including both natural stands and plantations (Figure 2-2b).

Cluster 3 corresponds to another garrigue type in Mediterranean Turkey, which is dominated by *Erica manipuliflora*, one of the typical low-shrub species of the region. These garrigues mainly occur in the lowlands in the southern Aegean region and western part of southern Turkey (Figure 2-3).

Cluster 4 is also divided into two groups. First, *Arbutus andrachne*, *Quercus coccifera* and *Juniperus excelsa*-dominated macchia and sclerophyllous forests occur especially in lowland to submontane belts of the southern Aegean and southern Turkey, but they are also found in the northern part of Mediterranean Turkey (Figure 2-4a). Second, *Quercus ilex*-dominated shrublands and sclerophyllous forests dominated by *Quercus ilex* occur throughout the precipitation-richer Aegean region (Figure 2-4b); *Arbutus andrachne* and *Quercus coccifera* also appear as co-dominant in this vegetation type.

Cluster 5 corresponds to *Olea europaea* and *Phillyrea latifolia*-dominated macchia and sclerophyllous forests. *Ceratonia siliqua* occurs in this vegetation as a diagnostic species. This vegetation type has an extensive distribution in the lowland and low-mountain vegetation belts of southern Turkey (Figure 2-5).

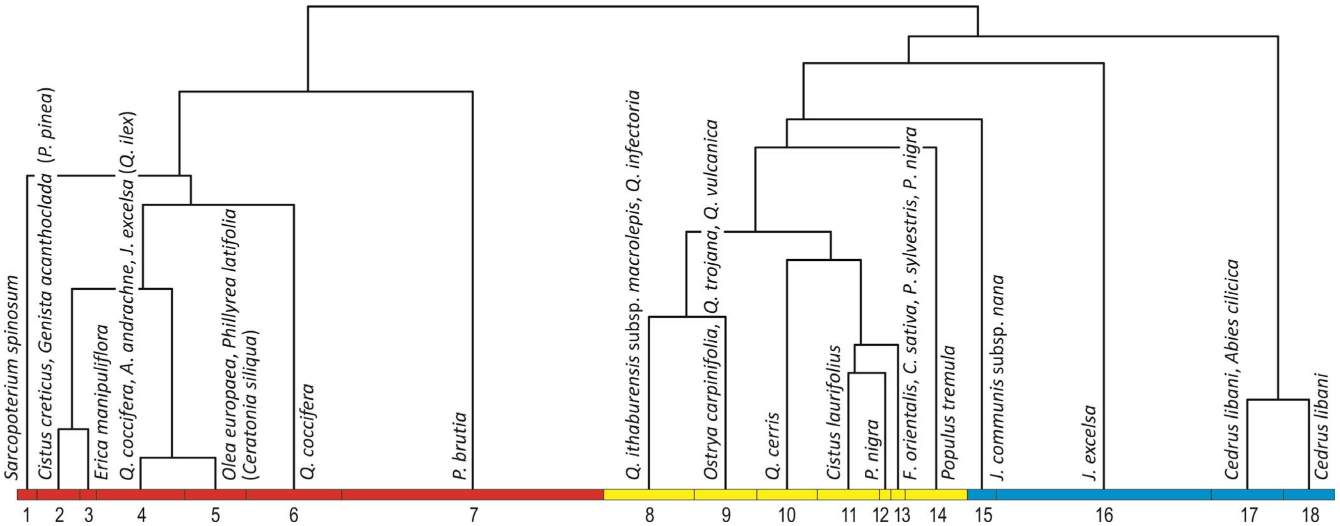


FIGURE 1 Hierarchical dendrogram of forests and shrublands in Mediterranean Turkey. Dominant species of each cluster are mentioned in the figure. In addition, *Pinus pinea* and *Quercus ilex* (in parentheses) are dominant in subgroups of clusters 2 and 4, respectively. *Ceratonia siliqua* is a diagnostic species and an important element for Cluster 5. Red line: thermo- and meso-mediterranean vegetation; yellow line: supra-mediterranean vegetation; blue line: oro-mediterranean vegetation. Legend: A.: *Arbutus*, C.: *Castanea*, F.: *Fagus*, J.: *Juniperus*, P.: *Pinus*, Q.: *Quercus*

Cluster 6 is another Mediterranean evergreen oak-dominated vegetation type formed by *Quercus coccifera*. The most characteristic feature of this cluster, in comparison with the previous *Quercus coccifera*-dominated vegetation types (4a and 4b), is a lower number of macchia shrub and tree species. Additionally, this vegetation type is more common at higher elevation belts than the previous ones. It is distributed throughout Mediterranean Turkey (Figure 2-6) and appears across a broad elevational gradient from lowland to highlands.

Cluster 7 is composed of pure *Pinus brutia*-dominated forests throughout Mediterranean Turkey. These forests occur from the sea level to the montane belt, and contain many garrigue, macchia and sclerophyllous forest species, such as *Cistus creticus*, *Phillyrea latifolia*, *Pistacia terebinthus*, *Quercus coccifera*, *Quercus infectoria* and *Styrax officinalis*. *Pinus brutia* forests in Mediterranean Turkey are represented by two different alliances: thermo- to meso-mediterranean *Pinus brutia* forests and meso- to supra-mediterranean *Pinus brutia* forests. Thus, we divided Cluster 7 into lowland and upland *Pinus brutia* forests in accordance with the further subdivision of this cluster in the dendrogram (Figure 2-7a and -7b).

Cluster 8 corresponds to deciduous oak forests in Mediterranean Turkey dominated by *Quercus ithaburensis* subsp. *macrolepis* and *Quercus infectoria*. This vegetation type ranges from the lowland to mountain elevational belt throughout Mediterranean Turkey (Figure 2-8).

Cluster 9 mainly consists of *Ostrya carpinifolia*-dominated forests. In addition, deciduous oak forests of *Quercus trojana* and *Quercus vulcanica* appear in this cluster. Deciduous trees and shrubs such as *Acer hyrcanum*, *Acer monspessulanum*, *Cornus sanguinea* and *Fraxinus ornus* are among the diagnostic species of this vegetation type. These forests appear in the central and western Taurus Mountains in southern Turkey (Figure 2-9).

Cluster 10 comprises another deciduous oak vegetation type, which is dominated by *Quercus cerris*. *Styrax officinalis* locally dominates the shrub layer. This vegetation type has a scattered distribution across a broad geographic range in Mediterranean Turkey (Figure 2-10).

Cluster 11 represents shrublands of the mountain belt dominated by *Cistus laurifolius*. These shrublands are associated with *Pinus nigra* and *Quercus cerris*-dominated forests and occur mostly in the inner parts of Mediterranean Turkey (Figure 2-11).

Cluster 12 corresponds to *Pinus nigra* forests. *Quercus cerris* and *Cistus laurifolius* are often present in this vegetation, in addition to *Juniperus oxycedrus*. These forests have an extensive distribution range in the inner parts of Mediterranean Turkey throughout the Aegean part and the Taurus Mountains in southern Turkey (Figure 2-12).

Cluster 13 includes forests dominated by temperate tree species, namely *Castanea sativa*, *Fagus orientalis* and *Pinus sylvestris*. *Pinus nigra* is also a dominant tree species for this group. However, other temperate tree species, such as *Abies nordmanniana* subsp. *equi-trojani*, *Carpinus betulus*, *Corylus avellana* and *Quercus petraea* appear as diagnostic species for this cluster. These forests mainly occur in the Aegean region. However, they are also distributed in the Amanos Mountains and nearby areas in the eastern part of southern Mediterranean Turkey (Figure 2-13).

Cluster 14 represents relict extrazonal deciduous *Populus tremula* forests. These forests were recorded in two areas, one in the northeastern part of Aegean Turkey, which is in contact with the Euro-Siberian biogeographical region, and the other in the Amanos Mountains in the eastern part of southern Mediterranean Turkey, which is also characterized by a significant occurrence of Euro-Siberian flora (Figure 2-14).

Cluster 15 represents shrublands dominated by *Juniperus communis* subsp. *nana*. This vegetation type mainly occurs in high mountains in the inner parts of the Aegean region and the western part of southern Mediterranean Turkey (Figure 2-15).

Cluster 16 includes *Juniperus excelsa*-dominated forests occurring at intermediate and high elevations of the Mediterranean mountains. These forests can reach the timberline in some areas. *Quercus coccifera* and *Juniperus oxycedrus* are often present in these forests, especially at lower elevations. These forests appear over large areas in the western and central Taurus Mountains in southern Mediterranean Turkey and in the inner part of the southern Aegean (Figure 2-16).

Cluster 17 consists of mountain and high-mountain forests dominated by *Abies cilicica* and *Cedrus libani* occurring in the central and eastern Taurus Mountains in southern Turkey. These forests cover extensive areas in the region characterized by the Mediterranean mountain climate (Figure 2-17). *Juniperus excelsa* and *Juniperus oxycedrus* are also common in this vegetation type.

Cluster 18 characterizes mountain and high-mountain forests dominated by *Cedrus libani* in the western Taurus Mountains (Figure 2-18). The absence of *Abies cilicica* in this group may be due to wetter site conditions in this western type compared with the previous cluster. *Juniperus excelsa* is often present in these forests.

3.2 | Environmental gradients

Canonical correspondence analysis (CCA) showed that elevation and all bioclimatic variables are significantly correlated to the floristic composition of Mediterranean forests and shrublands in Turkey (Table 2). Elevation is the most important ecological factor, causing clear elevational differences between vegetation types (Figure 4). The elevation is followed by mean temperatures (annual and of driest, coldest and warmest quarters), minimum temperature of winter, precipitation of warmest and driest quarters and precipitation seasonality. As expected, this indicates the correlation between climatic variables and elevational belts of the Mediterranean region (thermo- and meso-, supra- and oro-mediterranean).

The results of the DCA ordination of the 21 forest and shrubland vegetation types in Mediterranean Turkey are shown in Figure 5. We found three well-differentiated groups representing the main elevational belts in Mediterranean Turkey.

The first group represents vegetation from the thermo- and meso-mediterranean belts, such as phrygana, garrigue, macchia, sclerophyllous forests and pine forests dominated by *Pinus brutia* and *Pinus pinea*. This group is characterized by high values of the annual mean temperature, mean temperature of the coldest month, mean temperatures of the driest, warmest and coldest quarters and precipitation seasonality, i.e. the characteristic features of the Mediterranean climate.

The second group includes forests of *Ostrya carpinifolia*, *Pinus nigra*, *Populus tremula* and *Quercus cerris*. Additionally, *Cistus laurifolius*-dominated shrublands and forests dominated by temperate trees have similar environmental conditions. This group is related to high precipitation of the driest month and warmest quarter, indicating the supra-mediterranean affinity of this vegetation group.

The third group is represented by the forests dominated by *Abies cilicica*, *Cedrus libani*, *Juniperus excelsa* and *Juniperus communis* subsp. *nana* shrubland. These forests and shrublands occur at high elevations of the Mediterranean mountains (oro-mediterranean belt).

Forests of *Quercus ithaburensis* subsp. *macrolepis* and *Quercus infectoria* are in the centre of the ordination space, corresponding to intermediate environmental conditions.

4 | DISCUSSION

4.1 | Broad vegetation patterns

We identified 21 main vegetation types of forests and shrublands in Mediterranean Turkey. Elevation appeared as the most important factor affecting the variation in this vegetation in Mediterranean Turkey, followed by macroclimatic factors. In other parts of the Mediterranean Basin, elevation is also an important factor affecting climate and, consequently, the development of different vegetation types (Blondel & Aronson, 1999; Quézel & Médail, 2003; Gauquelin et al., 2016; Médail et al., 2019). It shows the correlation between elevation, climatic variables and vegetation.

This elevational and macroclimatic variation in Mediterranean Turkey is reflected in the differentiation of three distinct vegetation belts: (a) thermo- and meso-mediterranean vegetation represented by phrygana, garrigue, macchia, sclerophyllous forests and pine (*Pinus pinea* and *Pinus brutia*) forests; (b) supra-mediterranean pine (*Pinus nigra* subsp. *pallasiana*) and deciduous forests (*Quercus cerris*, *Quercus trojana*, *Quercus vulcanica*, *Ostrya carpinifolia* and *Populus tremula*) and also forests dominated by temperate tree species and *Cistus laurifolius* shrubland; and (c) oro-mediterranean coniferous forests (*Abies cilicica*, *Cedrus libani* and *Juniperus excelsa*) and shrubland (*Juniperus communis* subsp. *nana*). This elevational zonation follows the general pattern found in the Mediterranean mountains as described by Ozenda (1975).

The thermo- and meso-mediterranean belts and the supra-mediterranean belt show differences in precipitation in the growing season and in the drought period. Although the annual precipitation is lower in the supra-mediterranean than in the thermo- and meso-mediterranean belt in Mediterranean Turkey, the supra-mediterranean belt has higher precipitation in the driest period (summer; Mayer & Aksoy, 1986). Additionally, winter frost occurs regularly in the supra-mediterranean area. The mean temperature of the coldest quarter is thus lower in this belt.

In contrast, the oro-mediterranean belt is characterized by a subhumid mountain climate with cool summers with occasional orographic rainfall whereas winters are snowy and cold (Atalay

TABLE 1 Shortened synoptic table of the percentage frequencies of the dominant and diagnostic species of the vegetation types classified at the alliance level; species are sorted by decreasing values of the phi coefficient; only species with φ-values >0.20 and >15% frequency are shown and indicated by grey shading; the species that are not diagnostic but have >10% frequency in the whole table are shown at the bottom of the table. (1) *Sarcopoterium spinosum* phrygana; (2a) *Cistus creticus* garrigue; (2b) *Pinus pinea* forest; (3) *Erica manipuliflora* garrigue; (4a) *Arbutus andrachne*, *Quercus coccifera* and *Juniperus excelsa* sclerophyllous forest and shrubland; (4b) *Quercus ilex*, *Arbutus andrachne* and *Quercus coccifera* sclerophyllous forest and shrubland; (5) *Olea europaea* sclerophyllous forest and shrubland; (6) *Quercus coccifera* sclerophyllous forest and shrubland; (7a) Upland *Pinus brutia* forest; (7b) Lowland *Pinus brutia* forest; (8) *Quercus ithaburensis* and *Quercus infectoria* forest; (9) *Ostrya carpinifolia*, *Quercus trojana* and *Quercus vulcanica* forest; (10) *Quercus cerris* forest; (11) *Cistus laurifolius* shrubland; (12) *Pinus nigra* forest; (13) Forests dominated by temperate species; (14) *Populus tremula* forest; (15) *Juniperus communis* subsp. *nana* shrubland; (16) *Juniperus excelsa* forest; (17) *Abies cilicica* and *Cedrus libani* forest; (18) *Cedrus libani* forest. Full synoptic table is in Appendix S2

Vegetation type	1	2a	2b	3	4a	4b	5	6	7a	7b	8	9	10	11	12	13	14	15	16	17	18
No. of plots	81	87	32	47	197	66	156	249	649	238	273	63	192	88	655	190	35	44	192	268	269
Dominant trees																					
Pinus pinea	.	1	100	4	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Pinus brutia	2	10	53	49	23	38	9	7	99	100	3	.	8	.	1	.	.	.	.	1	3
Quercus ithaburensis subsp. *macrolepis*	2	.	6	.	5	.	1	2	5	.	27	.	4	.	.	.	.	.	.	.	.
Quercus infectoria subsp. *boissieri*	.	20	3	32	35	5	7	11	39	29	24	22	31	10	3	1	.	.	3	1	1
Ostrya carpinifolia	.	.	.	.	3	.	.	.	3	.	1	68	1	.	1	2	.	.	.	2	11
Quercus trojana	.	.	.	.	5	.	.	1	1	2	14	44	6	.	1	.	.	.	8	8	.
Quercus vulcanica	.	.	.	.	.	.	.	.	.	.	.	16	.	.	2	9	.	.	1	.	.
Quercus cerris	.	2	.	.	5	9	.	6	13	11	23	35	100	61	41	26	71	.	4	11	1
Pinus nigra subsp. *pallasiana*	.	.	.	.	.	.	.	1	2	1	8	.	9	26	100	55	57	2	3	14	4
Pinus sylvestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6	37	.	.	.	.	.
Fagus orientalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	47	.	.	.	.	.
Castanea sativa	.	.	6	.	.	.	.	.	1	.	.	.	.	.	4	26	.	.	.	.	.
Populus tremula	.	.	.	.	.	2	.	.	.	.	.	.	.	.	10	27	100	.	.	7	1
Juniperus excelsa	.	.	.	.	36	.	7	12	6	5	13	8	6	1	8	.	.	.	95	35	47
Abies cilicica	.	.	.	.	.	.	.	.	1	.	.	10	4	.	5	1	.	.	9	76	.
Cedrus libani	.	.	.	.	1	.	.	.	1	1	.	8	2	.	8	1	.	.	3	76	92
Dominant shrubs																					
Sarcopoterium spinosum	100	31	9	34	1	11	13	4	2	7	.	.	.	.	.	.	.	.	.	.	.
Cistus creticus	20	74	78	36	54	45	32	29	49	50	9	.	2	.	2	.	.	.	5	2	1
Genista acanthoclada	4	40	.	47	6	12	19	5	6	4	.	.	.	.	1	.	.	.	.	.	.
Erica manipuliflora	.	21	.	100	4	.	4	.	3	11	.	.	1	.	1	.	.	.	.	.	.
Phillyrea latifolia	4	18	9	68	86	74	59	33	42	55	8	.	10	2	2	1	.	.	9	.	.

(Continues)

TABLE 1 (Continued)

Vegetation type	1	2a	2b	3	4a	4b	5	6	7a	7b	8	9	10	11	12	13	14	15	16	17	18
Arbutus andrachne	.	2	.	2	60	91	15	8	8	40	.	5	4	.	1	.	.	.	.	.	1
Quercus coccifera	21	10	56	38	90	71	68	100	68	67	11	2	21	3	3	2	.	.	32	12	24
Quercus ilex	.	.	.	.	1	38	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Olea europaea	15	2	19	32	44	52	79	12	12	22	3	.	.	.	.	.	.	.	1	.	.
Cistus laurifolius	.	3	3	.	.	.	.	2	4	.	6	.	26	100	40	19	74	5	.	.	.
Juniperus communis subsp. *nana*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	100	.	.	.
Diagnostic species																					
(1) *Sarcopoterium spinosum* phrygana																					
Anagallis arvensis	72	8	.	11	1	.	7	3	2	.	4	.	1	.	1	.	.	.	4	.	.
Hymenocarpos circinnatus	42	.	.	4	3	.	6	8	4	1	1	.	.	.	.	.	.	.	.	.	.
Lysimachia linum-stellatum	27	1	.	.	1	.	1	.	1	1	1	.	.	.	.	.	.	.	.	.	.
Rumex bucephalophorus	28	2	.	2	1	.	.	1	1	.	7	.	2	.	.	.	.	.	.	.	.
Plantago lagopus	31	.	.	9	1	.	4	3	2	1	1	.	.	.	.	.	.	.	1	.	.
Anthemis arvensis	20	.	.	.	.	.	.	2	1	.	.	.	1	.	.	.	.	.	.	.	.
Sherardia arvensis	46	3	25	.	4	5	17	7	4	1	2	.	1	.	.	.	.	.	1	1	.
Aphanes arvensis	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.
Pallenis spinosa	17	1	.	.	.	.	2	1	.	.	1	.	.	.	.	.	.	.	.	.	.
Hippocrepis unisiliquosa	17	3	.	.	.	.	.	3	1	.	1	.	.	.	.	.	.	.	.	.	.
Onobrychis caput-galli	22	.	.	4	.	.	6	5	3	1	.	.	.	.	.	.	.	.	.	.	.
Parentucellia latifolia	19	.	.	.	.	.	1	1	2	.	4	.	2	.	1	.	.	.	1	.	.
Plantago cretica	21	7	.	.	.	.	1	7	2	.	.	.	.	.	.	.	.	.	.	.	.
Trifolium stellatum	41	16	9	9	6	8	9	11	11	.	14	.	2	.	1	.	.	.	4	.	.
Medicago orbicularis	22	.	.	2	1	.	3	6	3	1	5	.	.	.	.	.	.	.	.	1	3
Pyrus amygdaliformis	28	1	3	.	1	15	3	11	5	1	7	.	2	1	1	.	.	.	.	.	.
Lagoecia cuminoides	31	.	.	.	5	6	22	13	2	2	17	.	.	.	.	.	.	.	5	2	.
Crepis foetida	38	10	22	.	5	3	25	9	8	5	18	.	1	.	1	1	.	.	6	4	.
Briza maxima	35	26	13	6	3	2	24	6	4	.	9	.	.	.	1	.	.	.	1	.	3
Aira elegantissima	27	5	16	19	1	5	6	4	2	1	2	.	1	2	1	1	.	.	.	.	1
Geranium molle	17	.	.	.	3	.	10	2	2	1	1	.	2	.	1	.	.	.	.	4	.
Tordylium apulum	17	3	.	.	.	.	1	6	7	1	8	.	.	.	.	.	.	.	.	.	.
Scorpiurus muricatus	16	5	.	9	.	.	4	2	1	.	2	.	.	.	.	.	.	.	.	.	.

(Continues)

TABLE 1 (Continued)

Vegetation type	1	2a	2b	3	4a	4b	5	6	7a	7b	8	9	10	11	12	13	14	15	16	17	18
Galium brevifolium	17	3	6	.	.	.	15	4	2	.	1	.	.	.	1	.	.	.	.	.	.
Medicago minima	23	13	.	.	4	.	6	17	6	1	15	.	2	.	1	.	.	.	5	1	2
(2a) *Cistus creticus* garrigue																					
Stipa capensis	4	26	3	.	.	.	1	5	2	.	1	.	.	.	.	.	.	.	.	.	3
Micromeria nervosa	.	18	.	2	6	.	7	2	1	4	.	.	.	.	.	.	.	.	.	.	.
Trifolium angustifolium	17	23	6	.	4	.	3	8	7	3	10	.	2	.	1	.	.	.	.	.	.
Fumana thymifolia	15	20	.	2	4	5	1	9	4	4	1	.	.	.	.	.	.	.	1	.	.
(2b) *Pinus pinea* forest																					
Briza media	.	.	38	.	.	.	.	.	1	.	3	.	1	.	4	3	.	.	.	.	.
Cynosurus cristatus	.	9	34	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.
Bromus erectus	1	2	34	.	1	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	6
Saxifraga cymbalaria	.	.	22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cynosurus echinatus	14	2	69	30	2	2	5	12	17	4	17	11	8	.	1	.	.	.	14	7	2
Clematis vitalba	.	.	28	.	2	.	.	.	1	.	.	11	1	.	.	.	.	.	.	.	.
Cynosurus effusus	2	2	25	.	1	.	.	1	3	.	.	.	.	.	.	.	.	.	.	.	.
Asplenium adiantum-nigrum	.	.	19	.	1	.	1	.	.	.	.	.	.	.	1	1	.	.	.	.	.
Bellis perennis	.	.	28	.	.	2	3	1	4	.	.	.	5	.	1	.	.	.	4	1	.
Taraxacum hybernum	.	1	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.
Capparis spinosa	.	2	22	.	1	.	3	1	1	2	.	.	.	.	.	.	.	.	.	.	.
Aira caryophyllea	.	.	16	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	1	.
Trifolium tomentosum	4	1	28	11	2	3	1	2	2	.	.	.	.	.	.	.	.	.	.	.	.
Nigella arvensis	.	.	19	.	.	.	.	3	.	.	2	.	.	.	1	.	.	.	.	.	1
Globularia alypum	.	.	16	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plantago afra	5	.	19	.	1	.	5	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Gagea graeca	2	.	22	9	1	2	5	1	2	.	.	.	.	.	.	.	.	.	.	.	.
Cardamine graeca	.	3	28	.	1	12	6	2	2	1	.	.	2	.	1	3	.	.	1	6	1
Hordeum murinum	4	.	22	.	3	.	1	4	1	.	2	.	1	.	.	1	.	.	.	.	6
Limodorum abortivum	.	.	25	2	.	8	1	.	6	3	1	.	.	.	9	6	.	.	.	1	.
Cerastium illyricum	4	1	19	2	.	.	1	4	3	.	3	.	.	.	1	.	.	.	.	.	.
Hypericum montbretii	1	.	22	.	.	.	.	.	.	.	1	.	6	.	7	7	9	.	.	.	.
Quercus pubescens	.	.	34	.	3	5	.	6	2	.	21	.	24	10	9	3	.	.	5	7	.

(Continues)

TABLE 1 (Continued)

Vegetation type	1	2a	2b	3	4a	4b	5	6	7a	7b	8	9	10	11	12	13	14	15	16	17	18
Psoralea bituminosa	11	6	22	.	4	12	.	1	2	1	.	3	.	.	.	.	.	.	.	.	.
Lotononis genistoides	.	.	19	.	.	.	.	5	4	6	12	.	4	.	2	1	.	.	.	5	.
Hyparrhenia hirta	10	11	25	2	10	.	17	7	2	10	1	.	.	.	.	.	.	.	.	.	12
(3) *Erica manipuliflora* garrigue																					
Cytisopsis dorycniifolia	.	1	.	36	5	.	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Hypericum adenotrichum	.	.	.	32	.	.	.	.	1	.	1	.	1	2	2	.	.	9	.	.	.
Stachys byzantina	.	.	.	21	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Scorzonera elata	4	11	13	38	1	.	13	.	2	2	.	.	1	.	1	.	.	.	.	.	.
Lupinus varius	1	.	.	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linum corymbulosum	4	14	.	32	.	3	6	2	1	.	.	.	.	.	.	.	.	.	.	.	.
Inula heterolepis	1	13	.	32	1	.	13	1	2	1	.	.	.	1	.	.	.	.	.	.	3
Andropogon distachyos	.	3	.	17	.	.	1	.	1	2	.	.	.	.	.	.	.	.	.	.	.
Cytinus hypocistis	.	5	.	23	.	2	.	1	14	3	.	.	.	.	.	.	.	.	.	.	.
Carlina corymbosa	10	.	.	21	3	.	4	1	2	1	.	.	1	.	.	.	.	.	.	.	.
Bupleurum gracile	.	10	.	17	.	.	3	.	1	.	.	.	.	.	.	.	.	.	.	.	1
Fumana arabica	12	14	.	30	6	.	12	4	5	2	2	.	.	.	1	.	.	.	.	.	.
Gladiolus anatolicus	.	1	.	19	2	.	4	.	3	5	.	.	6	.	.	.	.	.	.	.	.
Piptatherum coerulescens	2	18	38	47	9	5	33	18	11	27	2	.	.	.	1	.	.	5	11	4	.
(4a) *Arbutus andrachne*, *Quercus coccifera* and *Juniperus excelsa* sclerophyllous forest and shrubland																					
Phlomis leucophracta	.	.	.	.	20	.	3	.	3	9	.	.	1	.	.	.	.	.	6	3	.
(4b) *Quercus ilex*, *Arbutus andrachne* and *Quercus coccifera* sclerophyllous forest and shrubland																					
Hypericum empetrifolium	.	5	.	.	3	42	6	2	2	1	1	.	.	.	1	1	.	.	.	.	.
Tamus communis	1	.	19	2	13	65	12	8	6	3	3	8	7	.	1	2	.	.	3	1	1
Brachypodium retusum	1	5	.	.	.	20	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Laurus nobilis	.	.	.	.	7	23	4	1	1	3	.	.	.	.	.	.	.	.	.	.	.
Ruscus aculeatus	.	.	6	13	25	39	7	4	7	10	.	.	2	.	1	.	.	.	.	1	.
Rubia peregrina	2	.	6	9	5	23	.	7	1	.	.	.	.	.	.	.	.	.	.	.	.
Rubia tenuifolia	4	3	.	21	13	39	18	18	6	8	1	5	3	.	1	2	.	.	.	1	4
Piptatherum miliaceum	.	11	.	13	6	30	20	5	4	9	.	.	1	.	.	.	.	.	.	.	.
Salvia fruticosa	.	2	9	.	.	17	4	4	1	.	.	.	2	.	2	.	.	.	.	.	.
Asparagus acutifolius	25	3	19	17	25	50	38	23	33	37	7	3	6	.	.	.	.	.	1	1	1
Ceterach officinarum	.	2	.	.	8	27	18	3	3	3	.	21	2	.	.	.	.	.	10	8	1

(Continues)

TABLE 1 (Continued)

Vegetation type	1	2a	2b	3	4a	4b	5	6	7a	7b	8	9	10	11	12	13	14	15	16	17	18
(5) *Olea europaea* sclerophyllous forest and shrubland																					
Phlomis lycia	.	3	.	.	1	.	31	2	2	5	.	.	.	.	1	.	.	.	.	.	.
Phagnalon graecum	1	.	.	.	1	.	22	.	1	1	.	.	.	.	.	.	.	.	.	.	.
Ceratonia siliqua	.	.	.	.	7	5	28	2	1	10	.	.	.	.	.	.	.	.	.	.	.
Anthemis chia	10	.	.	.	.	.	22	6	4	.	.	.	.	.	.	.	.	.	3	.	.
Orlaya daucoides	9	.	.	11	1	2	29	5	3	1	8	.	2	.	1	.	.	.	7	1	.
Galium setaceum	12	9	.	.	3	.	23	3	1	1	.	.	.	.	1	.	.	.	.	.	.
Quercus aucheri	10	.	.	.	.	15	24	3	2	3	.	.	.	.	.	.	.	.	.	.	.
Trifolium hirtum	.	.	.	2	3	.	19	2	4	1	3	.	2	5	.	.	.	.	.	.	.
Geranium lucidum	1	.	.	.	1	14	24	6	5	.	1	.	2	.	1	2	.	.	1	2	1
Urospermum picroides	4	5	.	.	3	2	19	4	1	5	.	.	.	.	.	.	.	.	2	.	.
Urginea maritima	19	.	6	.	2	.	24	5	3	8	.	.	.	.	.	.	.	.	.	.	.
Campanula podocarpa	11	7	.	.	.	8	19	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arabis verna	2	.	.	.	2	3	19	1	6	.	2	.	.	.	.	.	.	.	5	4	3
Origanum onites	19	1	19	2	6	2	31	7	7	13	1	.	.	.	1	.	.	.	.	.	6
Crucianella latifolia	4	10	.	11	18	15	40	15	9	22	9	5	3	3	1	.	.	.	17	3	.
Daphne gnidioides	.	7	13	2	25	.	31	15	11	8	.	.	.	.	1	.	.	.	7	2	.
Euphorbia falcata	10	10	.	.	3	3	19	1	1	4	3	.	1	.	.	.	.	.	.	.	4
(6) *Quercus coccifera* sclerophyllous forest and shrubland																					
Valerianella vesicaria	7	5	.	.	2	.	.	22	7	.	5	.	2	.	1	1	.	.	9	3	1
Jasminum fruticans	.	1	.	.	26	.	12	30	7	6	13	5	3	2	1	.	.	.	23	5	8
Echinaria capitata	6	.	.	.	.	.	1	18	3	.	15	.	6	.	1	.	.	.	9	2	.
(7a) Upland *Pinus brutia* forest																					
Poa annua	.	.	.	.	.	.	.	1	19	1	.	.	.	.	1	.	.	.	.	.	.
Poa trivialis	.	.	.	.	1	.	1	3	17	1	.	.	2	.	2	9	.	.	.	.	.
Lathyrus aphaca	1	2	.	2	3	2	1	6	18	5	3	.	9	.	1	.	.	.	.	2	.
(7b) Lowland *Pinus brutia* forest																					
Myrtus communis	.	6	.	19	24	11	13	2	9	40	.	.	.	.	.	.	.	.	.	.	.
Cotinus coggygria	.	.	.	4	20	3	4	1	8	29	.	6	3	.	.	.	.	.	.	.	.
Lens ervoides	.	.	.	.	2	5	3	1	6	18	1	.	4	.	.	.	.	.	.	1	.
Stipa bromoides	.	16	.	23	21	9	13	10	15	41	2	6	13	.	2	.	.	.	18	8	5
Styrax officinalis	1	.	13	.	37	32	15	21	38	49	13	25	33	.	2	1	.	.	7	7	7

(Continues)

TABLE 1 (Continued)

Vegetation type	1	2a	2b	3	4a	4b	5	6	7a	7b	8	9	10	11	12	13	14	15	16	17	18
Lithodora hispidula	.	6	.	6	14	.	1	.	1	16	.	.	.	.	.	.	.	.	.	.	.
(8) *Quercus ithaburensis* and *Quercus infectoria* forest																					
Eryngium campestre	6	3	.	.	.	.	.	4	1	1	18	.	6	5	1	1	.	.	3	2	.
Crupina crupinastrum	12	10	.	.	9	5	7	11	7	.	26	.	2	.	1	.	.	.	8	2	.
Ziziphora capitata	2	.	3	.	3	.	.	2	4	1	17	.	3	.	1	2	.	.	5	9	1
(9) *Ostrya carpinifolia*, *Quercus trojana* and *Quercus vulcanica* forest																					
Opopanax hispidus	.	.	.	.	2	.	1	1	.	.	.	33	1	.	.	.	.	.	3	.	.
Festuca heterophylla	.	.	.	.	.	.	.	3	.	.	1	38	1	1	5	14	.	.	.	4	.
Paeonia mascula	.	.	.	.	.	6	1	4	1	.	.	30	.	.	1	1	.	.	.	2	2
Cornus sanguinea	.	.	.	.	2	.	.	.	1	.	.	22	3	.	.	.	.	.	.	.	.
Geum urbanum	.	.	.	.	1	.	.	1	1	.	1	43	18	1	4	6	.	.	9	7	7
Rubia rotundifolia	.	.	.	.	.	.	.	.	.	.	.	17	.	.	.	1	.	.	.	.	.
Serratula grandifolia	.	.	.	.	.	.	.	.	.	.	.	17	.	.	1	.	.	.	.	.	.
Myrrhoides nodosa	.	.	.	.	.	.	.	.	.	.	3	22	5	.	.	.	.	.	.	.	.
Eragrostis cilianensis	.	.	.	.	.	.	.	.	.	1	.	16	.	.	.	.	.	.	.	.	.
Fraxinus ornus	.	.	.	.	2	11	2	.	4	.	.	40	13	.	4	1	.	.	1	5	15
Epipactis condensata	.	.	.	.	.	3	.	3	1	.	1	24	.	.	4	.	.	.	3	3	.
Laser trilobum	.	.	.	.	.	.	.	1	.	.	2	22	1	.	4	7	.	.	.	1	.
Clinopodium vulgare	.	.	3	.	12	5	.	6	7	8	2	56	31	5	16	25	.	7	3	26	2
Elymus panormitanus	.	.	.	.	1	.	1	1	1	.	1	25	1	.	2	1	3	.	.	12	3
Acer monspessulanum	.	.	.	.	1	.	.	3	1	.	6	25	2	.	1	.	.	.	6	2	8
Acer hyrcanum	.	.	.	.	.	.	.	.	1	.	.	25	.	.	1	2	.	.	4	9	13
Erysimum goniocaulon	.	.	.	.	1	.	.	1	1	.	1	16	.	.	1	.	.	.	.	2	2
Coronilla emerus subsp. *emeroides*	.	.	.	.	19	9	.	7	7	5	3	38	18	.	2	1	.	.	1	4	3
Physospermum cornubiense	.	.	.	.	.	2	.	.	2	.	1	22	3	.	5	7	.	.	.	3	.
Lathyrus aureus	.	.	.	.	.	.	.	.	.	.	.	16	1	.	.	8	.	.	.	.	.
Galium lucidum	.	.	.	.	.	.	.	.	2	.	.	17	.	9	1	.	.	.	.	.	1
Lapsana communis	.	.	.	.	2	.	2	12	3	.	4	29	13	.	11	17	3	2	3	16	1

(Continues)

TABLE 1 (Continued)

Vegetation type	1	2a	2b	3	4a	4b	5	6	7a	7b	8	9	10	11	12	13	14	15	16	17	18
(10) *Quercus cerris* forest																					
Agrimonia eupatoria	.	.	.	.	1	.	.	1	1	.	1	.	18	.	1	2	.	.	.	1	2
Falcaria vulgaris	.	.	.	.	1	.	.	3	2	1	8	13	31	3	1	.	.	.	8	10	3
Prunus spinosa	2	.	.	.	.	.	.	.	1	.	5	.	16	.	1	1	.	.	.	.	.
Bunium ferulaceum	.	.	.	.	.	.	.	.	3	1	.	.	16	.	2	.	.	.	.	.	9
Galium verum	2	1	.	.	2	.	.	15	1	.	12	.	30	5	9	6	.	2	14	5	1
Cephalorrhynchus tuberosus	.	.	.	.	1	.	2	.	1	1	.	8	19	.	3	1	.	.	1	13	3
Crataegus monogyna	2	.	3	.	8	3	1	22	15	12	19	8	38	3	11	15	.	.	5	3	1
Festuca valesiaca	.	.	.	.	2	.	1	4	2	4	3	.	24	9	7	4	.	.	6	3	13
Lathyrus digitatus	.	.	.	.	.	.	.	8	3	.	6	17	27	9	8	2	.	.	6	12	.
Trifolium physodes	.	.	.	.	2	.	.	1	5	8	4	5	20	.	2	1	.	.	3	10	1
Coronilla varia	.	.	.	.	.	.	1	7	4	2	10	22	28	2	8	9	17	.	6	8	.
(11) *Cistus laurifolius* shrubland																					
Galium floribundum	.	.	.	.	2	2	.	1	1	.	1	.	.	40	1	.	.	.	1	1	.
Linaria simplex	.	2	.	.	.	.	.	1	2	1	5	.	.	32	1	.	.	.	2	2	.
Herniaria glabra	.	.	.	.	.	.	.	1	.	.	.	.	.	19	.	.	.	.	.	.	.
Silene supina subsp. *pruinosa*	.	.	.	.	.	.	.	4	.	.	2	.	.	23	1	.	.	.	1	1	.
Logfia arvensis	1	.	.	.	.	.	.	10	3	1	16	.	4	45	.	1	17	.	15	2	.
Verbascum insulare	.	.	.	.	.	.	.	.	.	.	.	.	.	16	1	.	.	.	.	.	.
Alyssum desertorum var. *desertorum*	.	.	.	.	1	.	1	2	4	.	.	.	1	20	1	.	.	.	.	1	.
Ziziphora taurica	1	7	6	.	.	.	1	5	2	.	5	.	.	32	1	.	.	7	3	2	.
Bromus squarrosus	4	14	.	.	1	.	.	6	2	1	15	3	1	43	2	.	29	5	9	1	5
Arabis nova	.	.	.	.	.	.	.	2	1	.	4	.	2	25	1	.	.	.	4	6	9
Sedum pallidum	.	.	.	.	1	.	.	2	1	.	1	.	2	28	5	6	.	11	14	4	1
Phleum exaratum	.	.	.	.	.	.	1	14	1	.	9	.	4	25	1	.	.	.	9	.	1
Salvia tomentosa	.	.	.	.	25	.	5	12	12	24	5	30	35	58	18	8	.	2	21	27	9
Holesteum umbellatum	.	.	.	.	.	.	.	2	2	.	.	.	.	16	1	.	.	2	3	.	4
Bromus tectorum	23	14	34	2	3	.	1	11	2	2	16	.	7	47	9	1	29	5	13	18	3
Juniperus oxycedrus	.	6	3	.	32	2	.	28	27	16	46	49	57	68	38	14	3	.	34	38	21
Vulpia ciliata	2	.	3	2	1	.	1	4	2	1	13	.	.	18	1	1	.	.	.	.	2

(Continues)

TABLE 1 (Continued)

Vegetation type	1	2a	2b	3	4a	4b	5	6	7a	7b	8	9	10	11	12	13	14	15	16	17	18
Minuartia mesogitana	4	.	.	.	4	.	5	1	2	1	5	3	.	23	1	.	17	.	10	1	1
Trifolium arvense	4	24	.	6	4	5	4	6	10	6	14	.	10	30	5	1	.	.	13	2	1
(13) Forest dominated by temperate species																					
Fragaria vesca	.	.	.	.	.	2	.	.	1	.	1	.	6	1	14	43	.	2	.	1	.
Asperula involucrata	.	.	.	.	.	.	.	.	.	.	6	.	15	.	12	41	.	2	.	1	.
Carpinus betulus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	18	.	.	.	.	.
Cirsium hypoleucum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	19	.	.	.	.	.
Galium paschale	.	.	.	.	.	.	.	.	.	.	.	.	2	.	9	25	.	.	.	.	.
Veronica officinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	17	.	.	.	.	.
Quercus petraea	.	.	.	.	.	.	.	.	.	.	3	.	.	.	9	30	9	.	.	3	.
Corylus avellana	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	16	.	.	.	.	.
Stellaria holostea	.	.	.	.	.	.	.	.	1	.	.	.	2	.	3	19	.	.	.	.	.
Galium rotundifolium	.	.	.	.	1	.	.	.	.	.	.	.	.	.	4	19	.	.	.	2	.
Veronica chamaedrys	.	.	.	.	.	.	1	.	1	.	.	.	5	.	15	24	.	.	.	.	1
Rubus caesius	.	.	.	.	.	.	.	.	1	1	.	13	2	.	2	17	.	.	.	.	.
Sorbus torminalis	.	.	.	.	1	.	.	.	2	.	.	17	6	.	9	24	.	.	.	7	3
Viola sieheana	.	.	.	.	2	.	.	.	1	.	1	6	2	.	9	18	.	.	.	3	.
Cytisus pygmaeus	.	.	.	.	.	.	.	.	.	.	1	.	2	5	11	20	.	.	.	.	3
Trifolium alpestre	.	.	.	.	.	.	.	.	.	.	.	.	8	10	11	18	.	.	.	.	.
Pilosella piloselloides	.	.	3	.	.	.	.	2	3	.	10	.	8	13	14	26	6	.	2	4	3
(14) *Populus tremula* forest																					
Cytisus hirsutus	.	.	.	.	1	3	.	.	1	.	.	.	5	1	3	7	86	.	.	.	.
Erysimum smyrnaeum	.	.	.	.	.	.	.	.	.	.	2	.	1	13	1	.	89	5	.	1	3
Saponaria glutinosa	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	1	69	.	.	.	5
Myosotis discolor	.	.	.	.	.	.	.	.	.	.	.	.	.	23	.	.	80	.	.	.	.
Silene compacta	.	.	.	.	.	.	.	1	.	.	.	3	2	3	6	4	80	.	.	6	1
Verbascum × splendidum	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	57	.	.	.	.
Arabis sagittata	.	.	.	.	.	.	.	.	1	1	.	5	3	.	2	1	63	.	.	.	.
Petrorhagia alpina	.	.	.	.	.	.	.	.	.	.	.	.	1	5	8	11	54	2	.	7	.
Micropyrum tenellum	.	.	6	.	.	.	.	1	.	.	.	.	.	14	1	1	46	.	.	.	.
Poa nemoralis	.	.	.	.	.	3	.	3	1	.	2	30	35	2	13	23	86	.	15	18	1
Linaria genistifolia subsp. *genistifolia*	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	23	.	.	.	.

(Continues)

TABLE 1 (Continued)

Vegetation type	1	2a	2b	3	4a	4b	5	6	7a	7b	8	9	10	11	12	13	14	15	16	17	18
Galium aparine	.	.	.	.	1	3	3	4	2	.	5	11	4	.	5	3	46	.	.	4	1
Thlaspi violascens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	23	.	.	2	.
Fibigia eriocarpa	.	.	.	.	1	.	1	5	1	.	1	.	2	.	1	.	40	.	12	6	6
Anthemis tinctoria	.	.	.	.	2	.	.	14	3	.	27	32	21	26	17	13	80	.	21	18	1
Veronica dillenii	.	.	.	.	.	.	.	.	.	.	.	.	.	11	1	1	29	.	.	.	.
Stachys lavandulifolia	.	.	.	.	.	.	.	2	1	.	1	.	1	.	1	.	29	.	11	4	.
Cephalanthera rubra	.	.	.	.	.	.	.	5	5	1	4	2	5	3	14	10	40	.	2	9	1
Campanula lyrata	6	2	38	.	5	.	7	12	10	.	9	43	5	22	22	8	69	.	2	7	9
Trifolium medium	.	.	.	.	.	.	.	.	.	.	1	.	2	2	9	3	23	.	.	.	.
Hypericum perforatum	.	1	.	.	4	.	2	6	1	4	1	.	1	5	4	7	34	2	5	11	1
Silene italica	1	.	31	.	2	14	.	13	9	.	7	43	24	6	25	16	57	9	11	34	6
Colutea cilicica	.	13	19	15	4	14	.	11	7	1	1	8	10	.	1	1	34	.	4	1	5
Bromus sterilis	11	1	.	11	3	3	31	11	7	3	20	5	9	1	3	.	34	.	17	7	3
(15) *Juniperus communis* subsp. *nana* shrubland																					
Marrubium astracanicum	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	39	3	1	1
Hypericum linarioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	23	.	.	.
Bromus tomentellus	.	.	.	.	.	.	.	3	1	.	10	.	1	9	6	.	.	48	21	7	1
Thymus longicaulis	.	.	.	.	.	.	.	.	.	.	1	.	4	8	6	11	.	39	2	1	.
Poa alpina	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	25	.	.	7
Minuartia juressi	.	.	.	.	.	.	.	.	1	.	.	.	.	.	3	.	.	20	.	.	.
Daphne oleoides	.	.	.	.	1	.	1	4	1	.	3	.	.	.	6	.	.	39	7	14	5
Astragalus brachypterus	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	16	.	.	.
Rosa pulverulenta	.	.	.	.	.	3	.	.	1	.	.	.	3	.	3	9	.	30	.	4	12
Acantholimon ulicinum subsp. *ulicinum*	.	.	.	.	.	.	2	.	.	.	1	.	.	.	1	.	.	25	7	4	8
Minuartia anatolica	.	.	.	.	.	.	.	2	.	.	3	.	2	.	1	.	.	18	2	.	.
Pilosella hoppeana	.	.	.	.	.	.	.	4	1	1	4	.	8	15	20	22	.	39	1	3	1
Thymus zygioides	.	.	.	.	.	.	.	7	1	.	10	.	4	6	4	1	.	30	9	3	.
Astragalus angustifolius	.	.	.	.	.	.	.	16	4	1	16	.	8	5	5	.	.	41	28	12	3
Euphorbia herniariifolia	.	.	.	.	.	.	.	.	.	.	1	.	.	1	3	.	.	18	2	3	8
Cerastium dichotomum	4	.	.	.	.	.	.	2	1	.	8	6	4	.	3	2	.	18	6	5	2
Digitalis ferruginea	.	.	.	.	.	.	.	1	.	.	3	.	3	10	17	22	.	23	2	6	3

(Continues)

TABLE 1 (Continued)

Vegetation type	1	2a	2b	3	4a	4b	5	6	7a	7b	8	9	10	11	12	13	14	15	16	17	18
(16) *Juniperus excelsa* forest																					
Minuartia hamata	.	.	.	.	.	.	.	14	.	.	17	.	2	.	5	.	.	.	37	6	6
Ziziphora tenuior	.	.	.	.	1	.	2	6	1	.	10	.	.	.	3	.	.	.	24	4	.
Aubrieta canescens subsp. *canescens*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	16	.	10
Arenaria serpyllifolia	.	.	.	.	1	.	.	7	1	.	4	.	3	.	3	.	.	.	20	4	.
Minuartia multinervis	.	.	.	.	.	.	.	4	1	.	1	.	.	.	2	.	.	.	16	6	.
Phlomis grandiflora	.	.	.	.	8	.	1	3	13	2	.	.	2	.	.	.	.	.	22	7	3
Phlomis armeniaca	.	.	.	.	.	.	.	4	1	.	3	.	.	.	1	.	.	9	17	2	3
Berberis crataegina	.	.	.	.	.	.	.	7	3	3	21	22	18	3	10	.	.	18	40	16	20
Geranium tuberosum	.	.	.	.	1	.	1	11	2	.	5	5	4	.	4	1	.	2	23	20	6
Briza humilis	.	.	.	.	2	3	1	26	10	1	17	27	19	16	5	.	.	2	36	16	6
(17) *Abies cilicica* and *Cedrus libani* forest																					
Cyclamen cilicicum	.	.	.	.	2	.	.	.	1	1	.	.	.	.	1	.	.	2	6	23	.
Corydalis solida	.	.	.	.	.	.	.	1	2	.	.	.	.	.	4	2	.	5	9	27	.
Veronica cuneifolia	.	.	.	.	.	.	.	.	1	1	.	.	4	.	3	.	.	.	1	18	11
Anemone blanda	.	.	.	.	1	.	.	.	5	.	1	8	1	.	2	1	.	.	4	21	8
Juniperus drupacea	.	.	.	.	.	.	.	1	1	.	.	14	2	.	2	.	.	.	13	21	1
Thlaspi perfoliatum	.	.	.	.	1	5	.	4	4	.	6	21	7	.	7	2	.	.	17	26	12
Myosotis alpestris	.	.	.	.	.	.	.	.	.	.	3	2	7	.	5	3	3	5	6	17	7
(18) *Cedrus libani* forest																					
Anthemis rosea	.	.	.	.	1	.	2	2	1	.	.	.	.	.	.	.	.	.	3	3	35
Lonicera nummulariifolia	.	.	.	.	.	.	.	.	1	.	2	13	3	.	2	.	.	.	3	15	41
Vicia villosa	.	.	.	.	1	.	1	1	2	1	.	.	2	.	2	.	.	.	.	.	24
Astragalus macrourus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	17
Lolium temulentum var. *temulentum*	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	16
Bromus lanceolatus	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	16
Ranunculus argyreus	.	.	.	.	.	.	.	.	1	1	.	.	1	3	.	.	.	.	2	1	19
Crepis macropus	.	.	.	.	.	.	.	1	.	.	1	.	2	.	.	.	.	.	4	.	16
Verbascum sinuatum	.	.	.	.	1	.	.	1	2	1	.	.	2	.	1	.	.	.	.	.	16
Alliaria petiolata	.	.	.	.	.	.	.	.	.	.	.	13	5	.	1	3	.	.	.	2	20
Orchis palustris	.	.	.	.	.	6	2	.	1	.	.	.	.	.	1	.	.	.	.	7	17

(Continues)

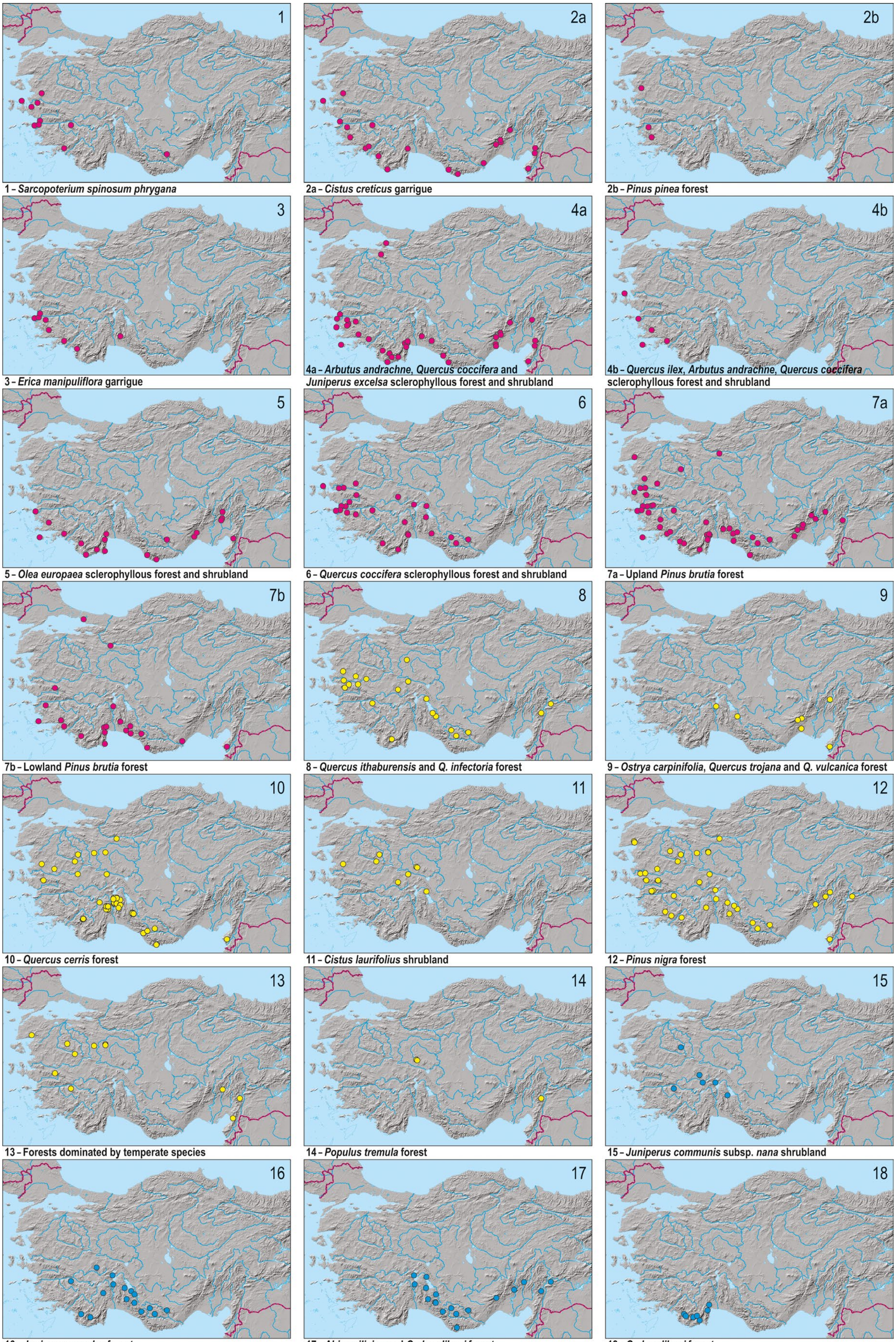
TABLE 1 (Continued)

Vegetation type	1	2a	2b	3	4a	4b	5	6	7a	7b	8	9	10	11	12	13	14	15	16	17	18
Diagnostic species for more than one alliance																					
Asphodelus aestivus	52	3	9	47	.	9	27	11	6	3	14	.	.	.	.	.	.	.	4	.	.
Galium murale	28	.	22	.	2	2	6	4	3	.	.	.	.	.	.	.	.	.	.	1	.
Theligonum cynocrambe	21	.	16	.	1	.	3	1	1	1	.	.	.	.	1	.	.	.	1	.	.
Valantia hispida	25	3	.	.	5	.	19	4	1	1	.	.	.	.	1	.	.	.	4	.	.
Trifolium campestre	59	23	56	30	10	15	22	29	26	20	13	.	11	15	7	1	.	.	9	1	1
Avena barbata	35	9	50	9	9	5	17	7	2	.	9	.	.	.	1	.	.	.	5	2	.
Trachynia distachya	31	28	.	9	9	3	37	10	5	7	3	.	.	.	2	2	.	.	5	1	1
Cistus salviifolius	5	45	13	47	14	24	19	6	4	21	.	.	.	.	1	.	.	.	.	.	.
Lavandula stoechas	6	34	91	34	3	2	12	1	4	4	.	.	.	.	.	.	.	.	.	.	.
Coridothymus capitatus	10	29	31	.	7	5	11	2	1	1	.	.	.	.	.	.	.	.	.	.	.
Anthyllis hermanniae	1	6	28	.	1	21	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.
Euphorbia characias subsp. *wulfenii*	.	.	34	23	13	3	41	8	5	14	.	.	.	.	.	.	.	.	.	.	.
Helichrysum stoechas	1	5	19	.	2	20	6	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Pteridium aquilinum	.	.	22	.	.	3	.	.	3	1	.	3	4	.	11	22	.	.	.	.	.
Aetheorhiza bulbosa	5	1	3	21	2	2	20	1	5	6	.	.	.	.	1	.	.	.	.	.	.
Teucrium divaricatum	.	18	19	32	3	39	15	6	4	3	.	.	.	.	.	.	.	.	.	.	.
Clematis cirrhosa	.	.	.	23	5	18	35	4	5	3	.	.	.	.	.	.	.	.	1	.	.
Pistacia terebinthus	2	8	6	47	80	52	35	49	41	58	23	2	17	5	2	1	.	.	11	2	4
Fontanesia phillyreoides	.	.	.	.	33	2	1	.	19	28	.	.	12	.	.	.	.	.	.	.	.
Eryngium falcatum	.	2	.	.	28	.	4	5	14	33	.	.	5	.	1	.	.	.	1	.	1
Smilax aspera	1	.	13	21	38	56	35	5	11	35	.	.	.	.	1	.	.	.	.	.	.
Melica minuta	.	.	.	.	2	24	21	2	3	3	.	.	.	.	1	.	.	.	.	.	1
Pistacia lentiscus	4	11	.	2	9	2.9	29	3	2	7	.	.	.	.	.	.	.	.	.	.	.
Arisarum vulgare	1	1	.	.	3	24	33	1	5	3	.	.	.	.	.	.	.	.	.	.	.
Selaginella denticulata	.	6	.	4	.	17	16	1	2	1	.	.	.	.	.	.	.	.	.	.	.
Cerastium fragillimum	.	.	.	.	.	.	.	4	2	2	13	29	6	3	6	.	.	.	28	24	4
Papaver apokrinomenon	.	.	.	.	.	.	.	1	1	.	1	14	.	.	1	.	.	18	1	1	.
Carex divulsa	.	.	.	.	.	.	.	1	2	3	2	22	31	2	5	5	.	.	1	7	.
Lathyrus laxiflorus	.	.	.	.	.	.	.	7	4	3	11	22	43	1	36	47	.	7	5	30	.
Brachypodium pinnatum	.	.	.	.	3	.	.	.	1	5	.	.	22	.	11	24	.	.	.	.	1

(Continues)

TABLE 1 (Continued)

Vegetation type	1	2a	2b	3	4a	4b	5	6	7a	7b	8	9	10	11	12	13	14	15	16	17	18
Veronica grisebachii	.	.	.	.	.	.	.	2	.	.	1	.	.	30	1	.	57	.	.	.	.
Hypericum origanifolium	.	.	.	.	.	.	.	.	1	.	.	.	.	22	1	.	34	.	3	2	.
Allium flavum	.	.	.	.	1	.	6	2	2	1	1	.	.	18	1	.	17	.	1	2	2
Acinos rotundifolius	.	1	.	.	1	.	6	13	4	1	10	13	6	40	4	.	51	.	35	11	18
Alyssum strigosum	4	.	.	.	5	.	9	34	8	7	23	.	5	38	4	.	.	2	42	22	1
Hypericum olympicum	.	.	.	.	.	.	.	.	1	.	.	.	.	14	2	4	.	16	.	.	.
Viscum album	.	.	.	.	.	.	.	.	1	.	1	.	2	.	17	14	.	.	.	2	.
Luzula forsteri	.	.	25	.	.	.	.	1	5	1	2	.	10	.	27	40	.	.	.	.	.
Rubus canescens	.	.	.	.	.	5	.	2	2	.	3	2	16	15	28	40	.	2	.	3	.
Turritis laxa	.	.	.	.	.	.	.	.	1	.	1	6	1	2	21	25	29	.	1	19	.
Euphorbia kotschyana	.	.	.	.	.	.	2	7	3	5	11	24	8	.	8	.	.	23	48	46	7
Juniperus foetidissima	.	.	.	.	1	.	.	2	1	.	10	.	1	3	2	.	.	.	28	13	26
Lamium garganicum	.	.	.	.	1	.	1	4	1	.	2	14	8	.	9	7	.	2	17	31	33
Bunium microcarpum	.	.	.	.	1	3	.	2	3	1	1	5	2	.	7	.	.	.	21	24	23
Calicotome villosa	6	48	25	49	28	26	47	7	7	16	2	.	1	.	.	.	.	.	3	.	.
Arabis caucasica	.	.	.	.	.	.	.	.	1	.	2	49	1	.	4	2	40	5	13	35	11
Galium peplidifolium	1	.	.	.	2	.	.	9	2	1	20	44	15	.	12	.	69	.	41	47	10
Non-diagnostic species with more than 10% frequency in the whole data set																					
Dactylis glomerata	38	24	41	40	28	20	25	39	38	34	47	24	52	39	34	24	26	11	23	51	20
Poa bulbosa	31	25	19	38	5	12	24	45	42	2	42	24	24	53	43	11	57	25	64	43	7
Teucrium chamaedrys	.	3	.	.	15	5	14	22	13	20	27	32	35	33	18	12	11	14	44	24	4
Teucrium polium	7	47	16	36	21	.	14	31	12	24	33	13	5	14	3	.	3	5	33	11	5
Vicia cracca	1	.	3	11	1	3	.	20	10	5	21	21	32	1	18	12	34	.	9	22	21
Doronicum orientale	.	.	6	.	1	6	.	8	6	2	3	13	16	.	28	11	.	11	7	25	19
Dorycnium pentaphyllum	.	.	.	.	3	2	1	14	14	9	11	10	15	5	19	28	.	5	4	11	.
Micromeria myrtifolia	14	29	31	30	24	15	41	18	9	22	3	.	.	.	1	.	.	.	21	4	.



1 – *Sarcopoterium spinosum phrygana*

2a – *Cistus creticus* garrigue

2b – *Pinus pinea* forest

3 – *Erica manipuliflora* garrigue

4a – *Arbutus andrachne*, *Quercus coccifera* and *Juniperus excelsa* sclerophyllous forest and shrubland

4b – *Quercus ilex*, *Arbutus andrachne*, *Quercus coccifera* sclerophyllous forest and shrubland

5 – *Olea europaea* sclerophyllous forest and shrubland

6 – *Quercus coccifera* sclerophyllous forest and shrubland

7a – Upland *Pinus brutia* forest

7b – Lowland *Pinus brutia* forest

8 – *Quercus ithaburensis* and *Q. infectoria* forest

9 – *Ostrya carpinifolia*, *Quercus trojana* and *Q. vulcanica* forest

10 – *Quercus cerris* forest

11 – *Cistus laurifolius* shrubland

12 – *Pinus nigra* forest

13 – Forests dominated by temperate species

14 – *Populus tremula* forest

15 – *Juniperus communis* subsp. *nana* shrubland

16 – *Juniperus excelsa* forest

17 – *Abies cilicica* and *Cedrus libani* forest

18 – *Cedrus libani* forest

FIGURE 2 Distribution of vegetation types in Mediterranean Turkey based on the analysis of a data set of 4,071 vegetation plots. Red points: thermo- and meso-mediterranean vegetation; yellow points: supra-mediterranean vegetation; blue points: oro-mediterranean vegetation

et al., 2014). Especially the Taurus Mountains in southern Turkey, running parallel to the coastline, receive humid air from the Mediterranean Sea, resulting in summer fog and rainfall (Atalay et al., 2018). This situation supports the productive *Abies cilicica* and *Cedrus libani* forests, which occur in the Taurus Mountains but are absent in western Turkey. This can be due to the perpendicular orientation of the mountain ranges in the western part to the coastline, which supports the penetration of the Mediterranean climate further inland and broader distribution of Mediterranean vegetation than in the south (Akman, 1995; Mayer & Aksoy, 1986).

4.2 | Syntaxonomy of Turkish Mediterranean forests and shrublands

4.2.1 | Phrygana

Based on the studies describing phrygana and garrigue communities in Turkey (Ayaşlıgil, 1987; Brullo et al., 1997; Kavgaci et al., 2017), the vegetation of Clusters 1 to 3 has been traditionally classified within the class *Cisto-Micromerietea julianae* and the order *Cisto-Micromerietalia julianae*. The class *Cisto-Micromerietea julianae* and the order *Cisto-Micromerietalia julianae* were merged with the class *Ononido-Rosmarinetea* by Mucina et al. (2016).

Phrygana is a vegetation type formed of low, thorny, chamaephytic (dwarf shrub) species. These communities are mostly the result of (over-)grazing, fire, and land abandonment. They usually represent a stage of secondary succession (Oberdorfer, 1954; Barbero & Quézel, 1989; Bergmeier, 2002).

Cluster 1 includes *Sarcopterium spinosum*-dominated communities that are common throughout the eastern Mediterranean region. Barbero & Quézel (1989) stated that *Sarcopterium spinosum* creates well-recognizable low phrygana communities, but it is difficult to identify the diagnostic species of higher syntaxa. This is because *Sarcopoterium spinosum* appears on formerly cultivated land and creates dense vegetation, which lasts for about 15 years in the successional series (Barbero & Quézel, 1989).

Sarcopoterium spinosum-dominated communities are rather difficult to classify. They need a broad-scale assessment in the future. However, Barbero & Quézel (1989) classified these communities within the alliance *Helichryso sanguinei-Origanion syriaci*, which was suggested as *nomen dubium* by Mucina et al. (2016). Therefore, a new name, *Origano syriaci-Hypericion thymifolii*, was proposed to encompass phryganas over calcareous bedrock (Mucina et al., 2016). Barbero & Quézel (1989) divided their alliance into three sub-alliances according to bedrock differences. In this classification, *Sarcopoterium spinosum*-dominated communities thriving over green rocks, serpentinites and gabbro were classified as the suballiance *Cisto salviifolii-Lavandulenion stoechadis*. The invalidity of the alliance name makes invalid also the sub-alliances (ICPN, Art. 4). Moreover, the authors failed to select a validly described association as a holotype (ICPN, Art. 5). Therefore, we decided to describe the new alliance *Cisto salviifolii-Lavandulion stoechadis* to include vegetation on non-carbonate bedrock. This new alliance (Appendix S2-1) is grouped under the order *Lavandulo stoechadis-Hypericetalia olympici* representing all phrygana vegetation on acidic siliceous and ultramafic substrates from the eastern Mediterranean within *Cisto-Lavanduletea stoechadis* (Mucina et al., 2016).

4.2.2 | Garrigue

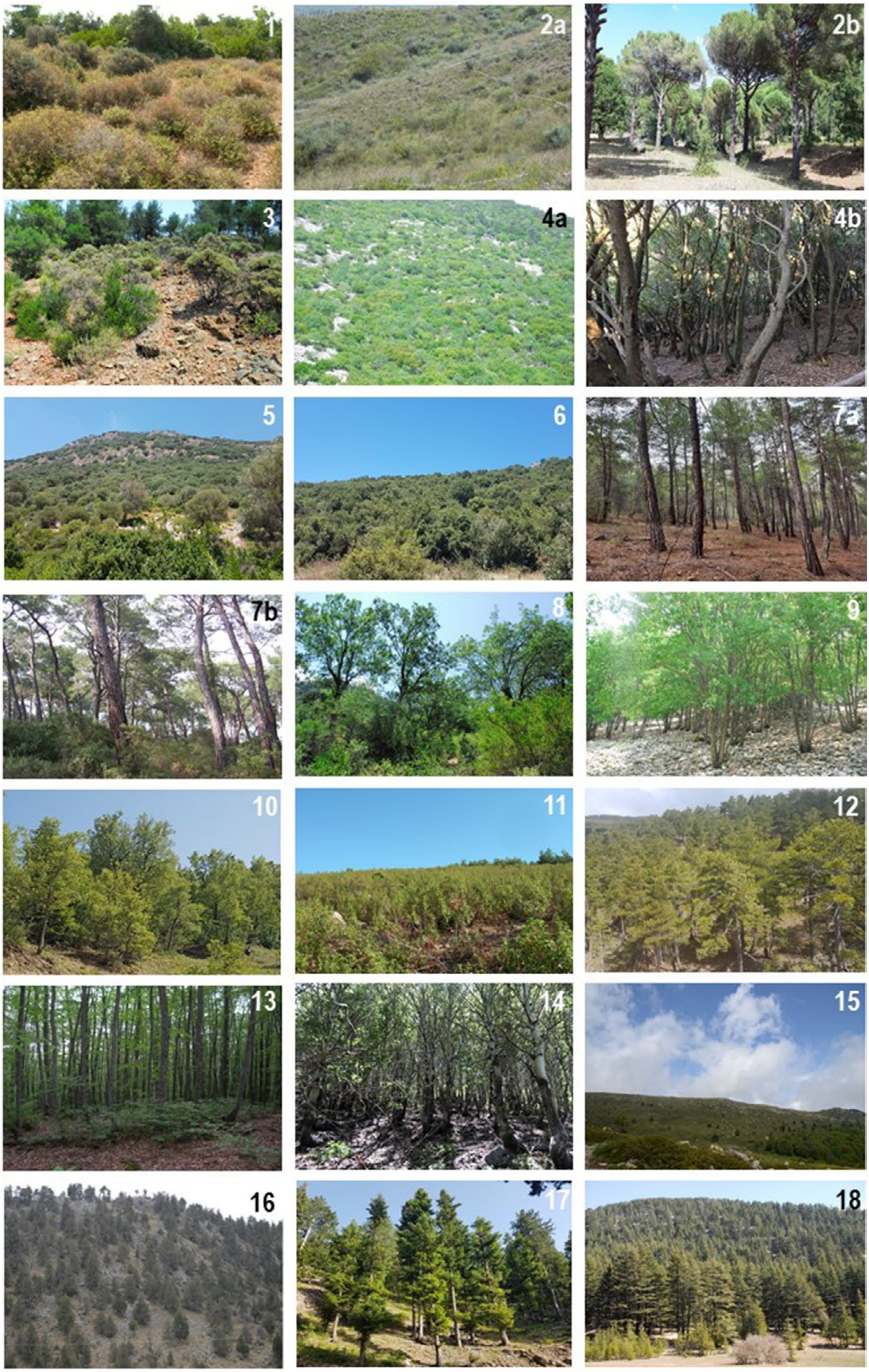
Garrigue is an open Mediterranean low scrub formation of browsed evergreen trees and shrubs, sub-shrubs and herbs resulting from long-term grazing, cutting and burning (Bergmeier et al., 2010). It is a successional stage and is maintained by grazing, fire, and summer aridity (Kavgacı et al., 2017).

Barbero & Quézel (1989) divided garrigue vegetation of the eastern Mediterranean based on geographical distribution into two alliances: *Hyperico empetrifolii-Micromerion graecae* appearing in more humid areas in the western part of the eastern Mediterranean and *Helichryso sanguinei-Origanion syriaci* (recte *Origano syriaci-Hypericion thymifolii* sensu Mucina et al., 2016) in the drier eastern parts. *Cistus creticus* and *Genista acanthoclada*-dominated garrigues appearing on calcareous bedrock are therefore grouped under the alliance *Origano syriaci-Hypericion thymifolii*. This is also supported by Kavgacı et al. (2017; Appendix S2-2a).

The current syntaxonomic scheme of garrigue vegetation highlights the importance of bedrock. Some syntaxonomic changes should therefore be implemented to meet this criterion. *Erica*-dominated communities in the eastern Mediterranean occurring on non-calcareous substrates are classified under the alliance *Helichryso barrelieri-Phagnalion graeci* (Mucina et al., 2009). Since the diagnostic species of this alliance (Mucina et al., 2016; *Erica manipuliflora*, *Cistus salviifolius*, *Genista acanthoclada*, *Helichrysum stoechas* subsp. *barrelieri*) are also diagnostic of our group, it has been classified under this alliance.

The alliance *Helichryso barrelieri-Phagnalion graeci* encompasses communities appearing in the western part of Turkey, which is more humid. Therefore, succession is faster approaching the next successional stage of macchia, i.e., taller shrubland. Many elements of macchia can be found in these communities, such as *Myrtus communis*, *Phillyrea latifolia* and *Pistacia terebinthus* (Appendix S2-3).

Other garrigue communities can be found at the upper elevational limit of Mediterranean vegetation (supra-mediterranean belt). They are stages of degradation of *Pinus nigra* forests and share many


1
2a
2b
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4a
4b
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7a
7b
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FIGURE 3 Typical stands of each vegetation type: (1) *Sarcopoterium spinosum* phrygana (Manavgat, Antalya, 200 m a.s.l.); (2a) *Cistus creticus* garrigue (Serik, Antalya, 160 m a.s.l.); (2b) *Pinus pinea* forest (Bergama, İzmir, 550 m a.s.l.); (3) *Erica manipuliflora* garrigue (Termessos, Antalya, 350 m a.s.l.); (4a) *Arbutus andrachne*, *Quercus coccifera* and *Juniperus excelsa* sclerophyllous forest and shrubland (Döşemealtı, Antalya, 550 m a.s.l.); (4b) *Quercus ilex*, *Arbutus andrachne*, *Quercus coccifera* sclerophyllous forest and shrubland (Davutlar, Aydın, 50 m a.s.l.); (5) *Olea europaea* sclerophyllous forest and shrubland (Kaş, Antalya, 200 m a.s.l.), (6) *Quercus coccifera* sclerophyllous forest and shrubland (Gelendost, Isparta, 1,100 m a.s.l.); (7a) Upland *Pinus brutia* forest (Korkuteli, Antalya, 900 m a.s.l.); (7b) Lowland *Pinus brutia* forest (Kemer, Antalya, 220 m a.s.l.); (8) *Quercus ithaburensis* and *Quercus infectoria* forest (Termesos, Antalya, 750 m a.s.l.); (9) *Ostrya carpinifolia*, *Quercus trojana* and *Quercus vulcanica* forest (Bayatbademler; Antalya; 950 m a.s.l.); (10) *Quercus cerris* forest (Aksu, Isparta, 1,200 m a.s.l.); (11) *Cistus laurifolius* shrubland (Simav, Kütahya, 1,050 m a.s.l.); (12) *Pinus nigra* forest (Beyağaç, Denizli, 1,300 m a.s.l.); (13) Forests dominated by temperate species (Dursunbey, Balıkesir 1,600 m a.s.l.); (14) *Populus tremula* forest (Çameli, Denizli, 1,750 m a.s.l.); (15) *Juniperus communis* subsp. *nana* shrubland (Simav, Kütahya; 1,950 m a.s.l.), (16) *Juniperus excelsa* forest (Sütçüler, Isparta, 1,450 m a.s.l.); (17) *Abies cilicica* and *Cedrus libani* forest (Alanya, Antalya, 1,750 m a.s.l.); (18) *Cedrus libani* forest (Elmalı, Antalya, 1,650 a.s.l.). Photo credits: M. Arslan (1, 11, 13, 15), A. Kavgacı (2a, 3, 4a, 5, 6, 7a, 7b, 8, 9, 10, 12, 16, 17, 18), E. Örtel (2b), Ü. Akkemik (4b), Y.S. Bostancı (14)

TABLE 2 Effects of environmental variables with the percentage of the total variance (PTV) of species data explained by canonical correspondence analysis (CCA) analysis

Variable	PTV	*P*-value	*F*-statistic
Elevation	0.55	0.001	33.58
Mean temperature of driest quarter (BIO9)	0.46	0.001	28.06
Annual mean temperature (BIO1)	0.46	0.001	28.01
Mean temperature of coldest quarter (BIO11)	0.46	0.001	27.96
Mean temperature of warmest quarter (BIO10)	0.45	0.001	27.87
Min temperature of coldest month (BIO6)	0.45	0.001	27.56
Precipitation of warmest quarter (BIO18)	0.45	0.001	27.41
Precipitation seasonality (BIO15)	0.44	0.001	27.19
Precipitation of driest month (BIO14)	0.44	0.001	27.08
Max temperature of warmest month (BIO5)	0.43	0.001	26.46
Mean temperature of wettest quarter (BIO8)	0.43	0.001	26.42
Precipitation of driest quarter (BIO17)	0.43	0.001	26.39
Precipitation of wettest quarter (BIO16)	0.38	0.001	23.11
Precipitation of coldest quarter (BIO19)	0.38	0.001	23.03
Precipitation of wettest month (BIO13)	0.37	0.001	22.88
Temperature seasonality (BIO4)	0.33	0.001	20.48
Isothermality (BIO3)	0.32	0.001	19.80
Annual precipitation (BIO12)	0.30	0.001	18.60
Temperature annual range (BIO7)	0.26	0.001	15.66
Mean diurnal range (BIO2)	0.19	0.001	11.56

common species with them (Atalay & Efe, 2010). In phytosociological studies describing *Cistus laurifolius* shrubland in Turkey, these communities are often identified as an association and are related to relict *Pinus nigra* forests (Hamzaoğlu & Duran, 2004; Ture et al., 2005) or thermophilous deciduous forests (Sağlam, 2013) in terms of floristic similarity. Since the contemporary vegetation classification integrates, in addition to floristic criteria, the physiognomy of the vegetation (Pignatti et al., 1995; Mucina et al., 2016; Bonari et al., 2021), *Cistus laurifolius*-dominated phrygana must be separated from forest vegetation. A vicariant alliance called *Cistion laurifolii* exists in the western Mediterranean (Escudero et al., 1996; de Foucault et al., 2012). Because of the floristic and macroecological differences in the eastern Mediterranean, *Cistus laurifolius*-dominated shrublands in Mediterranean Turkey have been identified as a new alliance called *Galio floribundi-Cistion laurifolii* (Appendix S2-11).

4.2.3 | Macchia and sclerophyllous forests

Macchia is evergreen sclerophyllous shrubland with a more or less closed canopy structure. It is a stage of vegetation succession towards the forest, replacement stage of climax forests, or even permanent communities on xeric sites. These stages are maintained by grazing, forest clearing and fires. Unless the succession is interrupted, macchia develops into a sclerophyllous forest, but the species composition is nearly the same (Kavgacı et al., 2010). Macchia and sclerophyllous forests are therefore often treated together in vegetation classification (e.g., Čarni et al., 2011, 2018; Kavgacı et al., 2017).

Macchia and sclerophyllous forests used to be grouped with *Pinus brutia* and *Pinus pinea* forests and classified within the class *Quercetea ilicis* in Turkey (Quézel et al., 1993; Ketenoğlu et al., 2010). Recently,

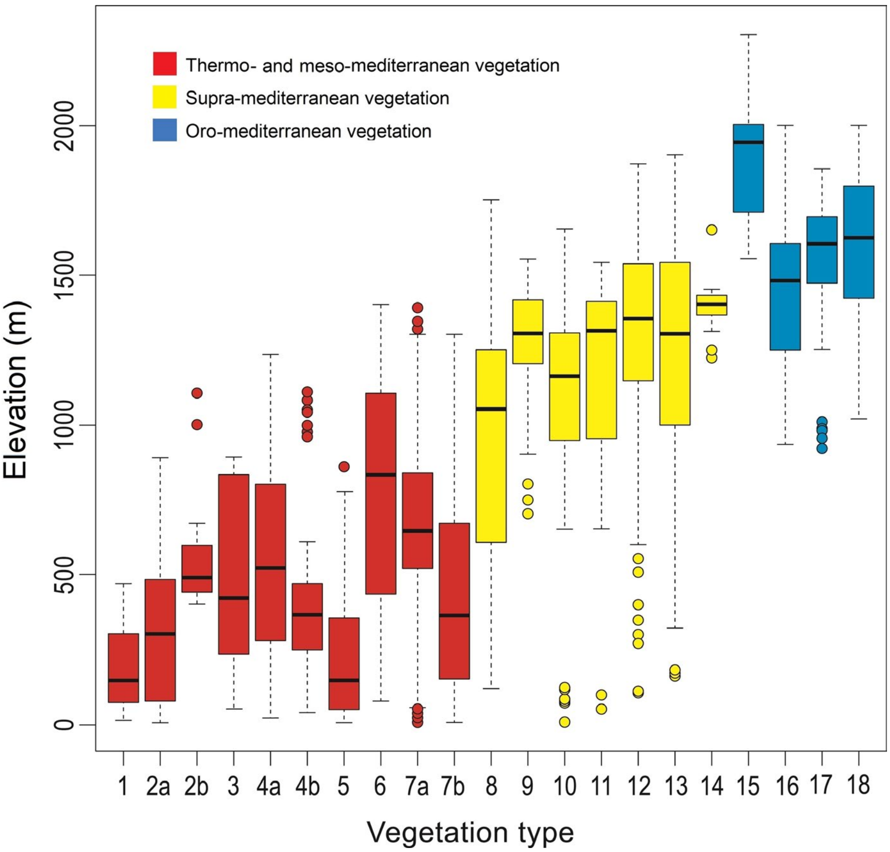

FIGURE 4 Forest and shrubland types in Mediterranean Turkey along an elevational gradient. See Table 1 and the text for the explanation of the vegetation type codes

Pinus brutia and *Pinus pinea* forests were separated within the new class *Pinetea halepensis* (Bonari et al., 2021). Our results show that macchia and sclerophyllous forests in Turkey can be divided into four groups corresponding to four alliances classified within three orders.

The first order, *Quercetalia ilicis*, occurs in more humid parts of the area. It includes two alliances, *Arbuto andrachnes-Quercion cocciferae* and *Cyclamini cretici-Quercion ilicis*. The first alliance includes *Arbutus andrachne*, *Quercus coccifera* and *Juniperus excelsa*-dominated macchia and sclerophyllous forests of southern Mediterranean Turkey (Kavgacı et al., 2017). It was described as evergreen basiphilous mesic kermes oak forests of the Eastern Mediterranean by Mucina et al. (2016; Appendix S2-4a). However, especially in the more humid western Turkey, *Quercus ilex* also appears as a co-dominant species of vegetation with *Arbutus andrachne* and *Quercus coccifera*. These communities are classified within *Cyclamini cretici-Quercion ilicis*, encompasing mesic macchia and sclerophyllous forests (Appendix S2-4b). In the literature, *Quercus ilex*-dominated vegetation from western, more humid parts of the Mediterranean Turkey has always been placed in a different alliance (*Quercion ilicis*) than the southern Mediterranean *Arbutus andrachne*, *Quercus coccifera* and *Juniperus excelsa*-dominated vegetation (*Arbuto andrachnes-Quercion cocciferae*; Akman, 1995; Ketenoğlu et al., 2010). However, the alliance *Quercion ilicis* was identified as an alliance of holm oak forests of the western Mediterranean (Mucina et al., 2016).

The second order, *Pistacio lentisci-Rhamnetalia alaterni*, includes the thermo-mediterranean calcicolous macchia communities from the whole Mediterranean area. Within this order, *Ceratonio siliquae-Pistacion lentisci* represents thermo-mediterranean sclerophyllous xerophilous macchia and forests dominated by *Olea europaea* of the eastern Mediterranean (Mucina et al., 2016; Gianguzzi & Bazan, 2019; Şekerciler & Ketenoğlu, 2019; Appendix S2-5). This vegetation has been traditionally classified within *Oleo-Ceratonion siliquae* in Turkey (Ayaşlıgil, 1987; Akman, 1995; Ketenoğlu et al., 2010).

The third order, *Quercetalia cocciferae*, includes macchia and sclerophyllous forests dominated by *Quercus coccifera* from higher elevations of the meso-mediterranean to the supra-mediterranean belt. *Quercus coccifera* has an extensive distribution in Mediterranean Turkey and occurs in many different vegetation types. However, these types at higher elevations differ from the others in their floristic composition, especially in the absence or low abundance of other macchia shrubs and sclerophyllous trees.

There are various taxonomic concepts of *Quercus coccifera* agg. It is possible to understand it as two separate species, *Quercus calliprinos* and *Quercus coccifera* (Pignatti, 2017-2019), two subspecies (nominal and subsp. *calliprinos*; Schwarz, 1936a), or a single species *Quercus coccifera* (Greuter et al., 1986; Jasprica et al., 2016). Like the Flora of Turkey (Davis, 1965-1985, Vol. 7, p. 681), the checklist of Flora of Turkey (Güner et al., 2012, p. 507 and Euro+Med PlantBase (Euro+Med, 2006), we have accepted the last solution and treated *Quercus calliprinos* as a younger synonym of *Quercus coccifera*. Consequently, in accordance with Art. 44 of ICPN (Theurillat et al., 2021), we consider the names *Quercion calliprini* Zohary 1955 (Zohary, 1955, p. 352) and *Quercetalia calliprini* Zohary 1955 (Zohary, 1955, p. 323, 338) as inadequate names (*nom. inept.*; ICPN, Art. 44)

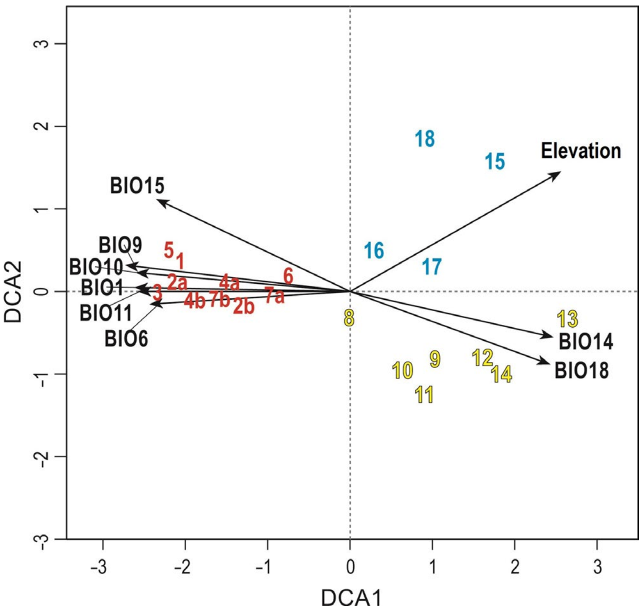

FIGURE 5 Detrended correspondence analysis (DCA) ordination of forest and shrubland vegetation types in Mediterranean Turkey. Elevation and BioClim data were passively projected on the ordination diagram. Only the eight most important BioClim variables in the canonical correspondence analysis (CCA) analysis are shown. For an explanation of vegetation type codes and BioClim data, see Tables 1 and 2, respectively

and correct them to *Quercion cocciferae* Zohary 1955 *nom. corr.* and *Quercetalia cocciferae* Zohary 1955 *nom. corr.* (Appendix S2-6).

4.2.4 | High-mountain scrub

Subalpine and supra-montane chionophobous calcicolous dry low juniper shrubland of the central and southern Apennines, south-central Balkans, Hellenic mainland and Turkey are grouped in the alliance *Daphno oleoidis-Juniperion alpinae* (Mucina et al., 2016; Bergmeier et al., 2018). We agreed with this classification and grouped *Juniperus communis* subsp. *nana*-dominated shrubland under *Daphno oleoidis-Juniperion alpinae* by including western Turkey within the geographical range of the alliance (Appendix S2-15).

4.2.5 | Coniferous forests

Pinus pinea forests show a high floristic similarity to *Cistus creticus* and *Genista acanthoclada* garrigues. Because of these similarities, these forests were previously included in *Cisto-Lavanduletea* (Brullo et al., 2002). However, the physiognomic difference (forest vs shrubland) suggests a classification of these forests within the alliance *Pinion pineae* under *Pinetalia halepensis* of the class *Pinetea halepensis* (Feinbrun, 1959; Mucina et al., 2016; Sarmati et al., 2019; Bonari et al., 2021). These communities are also distinguished from garrigues by the presence of other tree species, such as *Pinus brutia*, *Quercus coccifera* and *Quercus pubescens* (Appendix S2-2b).

Pinus brutia is a tree species with the largest distribution in Turkey, dominating forest stands across a total area of 5 million hectares (Boydak et al., 2006; Bonari et al., 2020). Like *Pinus halepensis*, it is a typical eastern Mediterranean pine which is mainly distributed in the western Mediterranean (Mauri et al., 2016). Many phytosociological studies have been carried out in Turkish *Pinus brutia* forests and have classified these forests in several different alliances of the *Quercetalia ilicis* (Quézel et al., 1993; Akman, 1995; Ketenoğlu et al., 2010). However, Pesaresi et al. (2017) emphasized that classification into *Quercetalia ilicis* does not discriminate Mediterranean needle-leaved forests from the evergreen sclerophyllous and deciduous Mediterranean vegetation and described the independent order *Pinetalia halepensis*. Bonari et al. (2021) included this order in the new class *Pinetea halepensis*. *Pinus brutia* forests in Mediterranean Turkey were classified in two alliances with different elevational distributions (Bonari et al., 2021): *Styraco officinalis-Pinion brutiae* (Appendix S2-7a) in the highlands and *Pinion brutiae* (Appendix S2-7b) at lower elevations.

In Turkish phytosociological studies, forests dominated by *Pinus nigra* subsp. *pallasiana*, the only subspecies of black pine in Turkey (Gülsoy et al., 2014), have been grouped under two different alliances: *Cisto laurifolii-Pinion pallasianae* in the Black Sea region and central Turkey and *Adenocarpo complicati-Pinion pallasianae* in Mediterranean Turkey (Akman, 1995; Ketenoğlu et al., 2010). The first alliance was also named *Pino-Cistion laurifolii* without any indication of association, making it invalid (Quézel et al., 1978). Bergmeier et al. (2018) were of the same opinion and they classified *Pinus nigra*-dominated forests in the Aegean and southern Mediterranean parts of Turkey under *Adenocarpo complicati-Pinion pallasianae*. Mediterranean *Pinus nigra* subsp. *pallasiana* forests are therefore grouped within this alliance (Appendix S2-12). However, some extrazonal occurrences of *Cisto laurifolii-Pinion pallasianae* in Mediterranean Turkey were also found (Kavgacı et al. 2012, 2013) and are described below. The lack of unique diagnostic species of *Adenocarpo complicati-Pinion pallasianae* is most likely related to the broad distribution range of the alliance and of its wide elevation range. Therefore, a revision of these forests is needed.

Juniperus excelsa has a wide distribution in the Mediterranean and Euro-Siberian phytogeographical regions of Turkey. These communities have been intensively studied. Many communities were described under different names (Ketenoğlu et al., 2010). In addition to the appearance of *Juniperus excelsa* in macchia and sclerophyllous forests in Mediterranean Turkey, it dominates juniper forests in the Mediterranean high mountains, often forming the timberline. Bergmeier et al. (2018) grouped the montane tall juniper forests of western Turkey under the alliance *Juniperion excelso-foetidissimae*, like those in the south-central Balkans and Greece (Matevski et al., 2010; Mucina et al., 2016). We also agree with the classification of Bergmeier et al. (2018) on *Juniperus excelsa*-dominated forests in Mediterranean Turkey (Appendix S2-16).

Cedrus libani covers an area of almost 400,000 hectares in the Taurus Mountains in southern Turkey (Kavgacı & Čarni, 2012), in addition to its limited distribution in Lebanon and Syria. It generally forms pure stands in southwestern Turkey (western Taurus Mountains) and is co-dominant with *Abies cilicica* in the central and eastern Taurus Mountains. This geographical differentiation also resulted in the syntaxonomic classification as *Lonicero nummulariifoliae-Cedrion libani* in the western Taurus Mountains and *Abieti cilicicae-Cedrion libani* in the central and eastern Taurus Mountains (Akman et al., 1978; Kavgacı & Čarni, 2012). Our classification supports this distinction between *Cedrus libani*-dominated forests in Mediterranean Turkey (Appendix S2-17–18).

4.2.6 | Deciduous forests

Quercus ithaburensis subsp. *macrolepis* and *Quercus infectoria* forests in Turkey have also been the subject of phytosociological studies (Duman, 1995; Kargıoğlu & Tatlı, 2005). These deciduous oak forests of the eastern Mediterranean mainly appear above the meso-mediterranean belt. They are grouped within the alliance *Quercion macrolepidis* of the order *Quercetalia pubescenti-petraeae* and the class *Quercetea pubescentis* (Bergmeier et al., 2018; Appendix S2-8).

Ostrya carpinifolia and *Quercus cerris* are diagnostic species of the alliance *Ostryo-Quercion pseudocerridis* (Akman et al., 1978; Quézel et al., 1978). *Quercus pseudocerris* is a synonym of *Quercus cerris* (Euro+Med, 2006). In our case, *Ostrya carpinifolia* and *Quercus cerris* are distinguished as dominants of different groups. In the description of the alliance *Ostryo-Quercion pseudocerridis*, the authors (Quézel et al., 1978) pointed out the similarity with the vegetation of the Balkan Peninsula and recognized two subtypes within this alliance. The first subtype consists of *Ostrya carpinifolia* and *Carpinus orientalis* forests, while the other subtype is *Quercus cerris*-dominated forests. The former subtype includes primary deciduous forests, while the latter includes mainly secondary forests occurring on sites of coniferous forests (Quézel et al., 1978). This distinction is also clearly seen in our data.

Quézel et al. (1978) and Akman et al. (1978) did not mention any association belonging to the alliance *Ostryo-Quercion pseudocerridis*, which is not in accordance with Art. 8 of the ICPN (Theurillat et al., 2021). Moreover, the concept of this alliance is not entirely clear (Uğurlu et al., 2012). The same authors failed in the typification of the alliance in 1993 (Quézel et al., 1993), since there is no indication of the bibliographical source of Quézel et al. (1978) and Akman (1973) for the type of the alliance (ICPN, Art. 2b; Theurillat & Moravec, 1996). Despite these deficiencies, this alliance was used in recent studies (e.g. Bergmeier et al., 2018). The ecological and geographical distinction between *Ostrya carpinifolia* and *Quercus cerris*-dominated forests, as well as the invalidity of the alliance *Ostryo-Quercion pseudocerridis*, led us to abandon this concept and describe two new syntaxa for these two vegetation types.

The group of thermophilous deciduous forests dominated by *Ostrya carpinifolia*, *Quercus trojana* and *Quercus vulcanica* occurs at higher elevations in the supra- and oro-mediterranean vegetation belts, where precipitation is more abundant, and temperature seasonality is less pronounced. Analogous vegetation can also be found on other mountains in the Mediterranean area, for instance, the alliance *Fraxino orni-Ostryion carpinifoliae* in the Balkans (Čarni et al., 2009; Stupar et al., 2016). We decided to suggest a new concept for these Mediterranean *Ostrya carpinifolia*, *Quercus trojana* and *Quercus vulcanica* forests and propose a new alliance, *Querco vulcanicae-Ostryion carpinifoliae* (Appendix S2-9).

Quercus cerris, a species having a large distribution throughout the Balkans and central Mediterranean (Di Pietro et al., 2020; Terzi et al., 2020), forms forests that are geographically separated from forests of the alliance *Querco vulcanicae-Ostryion carpinifoliae*. These forests have a large distribution range in Mediterranean Turkey, especially in the supra-mediterranean region, mainly between 800 and 1,300 m a. s. l. They occur on deep soils. We describe these forests as a new alliance, *Falcario vulgaris-Quercion cerridis* (Appendix S2-10).

Populus tremula is the second most widely distributed tree in the world, after *Pinus sylvestris* (Caudullo & de Rigo, 2016). In Turkey, it generally occurs in the Euro-Siberian area, and to a lesser extent in the Mediterranean region. *Pinus tremula*-dominated forests are grouped within the alliance *Fragario vescae-Populion tremulae*, representing relict extrazonal temperate deciduous birch and poplar forests on mineral soil in Europe (Mucina et al., 2016; Willner et al., 2016). In agreement with Bergmeier et al. (2018), we classified these forests in Turkey within this alliance (Appendix S2-14).

Temperate tree species (*Carpinus betulus*, *Castanea sativa*, *Corylus avellana*, *Fagus orientalis*) show an extrazonal distribution pattern in Mediterranean Turkey. These forests are the result of possible migration of Euro-Siberian floristic elements during past geological ages (Davis, 1971). These forests have been classified under many different syntaxa (Akman et al., 1979a; Bekat & Oflas, 1990; Varol & Tatlı, 2001; Tatlı et al., 2005; Kavgacı et al., 2013). However, our classification showed that they are a relatively homogeneous group, and they can be grouped under the same alliance. In our analysis, these forests showed a close similarity to *Pinus nigra*-dominated forests. Additionally, *Pinus nigra* commonly co-occurs in the floristic composition. Kavgacı et al. (2012) carried out a large-scale assessment of *Fagus orientalis* forests in Turkey, including their extrazonal distribution in the Mediterranean part of the country. In this work, these forests were classified within the alliance *Cisto laurifolii-Pinion pallasianae*, due to the high number of diagnostic species of this alliance. Therefore, it also seems suitable for the forests dominated by temperate tree species in Mediterranean Turkey to be classified, at least provisionally, under this alliance. However, these forests need further syntaxonomical studies (Appendix S2-13).

4.3 | Syntaxonomical scheme

Based on the above syntaxonomic discussion on Mediterranean forests and shrublands in Turkey, we propose the following syntaxonomic scheme (EVC: Alliance present in the EuroVegChecklist (Mucina et al., 2016); notEVC: Alliance not present in the EuroVegChecklist; New: Newly described alliance).

Cisto-Lavanduletea stoechadis Br.-Bl. in Br.-Bl. et al. 1940

Lavandulo stoechadis-Hypericetalia olympici Mucina in Mucina et al. 2016

Cisto salviifolii-Lavandulion stoechadis Kavgacı, Balpınar, Öner, Arslan, Bonari, Chytrý et Čarni 2021 *all. nov.* (Cluster 1 in Figure 1, Table 1-1, Figure 2-1) (New)

Helichryso barrelieri-Phagnalion graeci (Barbero & Quézel 1989) R. Jahn in Mucina et al. 2009 (Cluster 3 in Figure 1, Table 1-3, Figure 2-3) (EVC)

Galio floribundi-Cistion laurifolii Kavgacı, Balpınar, Öner, Arslan, Bonari, Chytrý et Čarni 2021 *all. nov.* (Cluster 11 in Figure 1, Table 1-11, Figure 2-11) (New)

Ononido-Rosmarinetea Br.-Bl. in A. Bolòs y Vayreda 1950

Hyperico empetrifolii-Genistetalia acanthocladae Mucina in Mucina et al. 2016

Origano syriaci-Hypericion thymifolii Mucina et Theurillat in Mucina et al. 2016 (Cluster 2 in Figure 1, Table 1-2a, Figure 2-2a) (EVC)

Loiseleurio procumbentis-Vaccinietea Eggler ex Schubert 1960

Vaccinio microphylli-Juniperetalia nanae Rias-Mart. et M. Costa 1998

Daphno oleoidis-Juniperion alpinae Stanisci 1997 (Cluster 15 in Figure 1, Table 1-15, Figure 2-15) (EVC)

Quercetea ilicis Br.-Bl. ex A. Bolòs et O. de Bolòs in A. Bolòs y Vayreda 1950

Quercetalia ilicis Br.-Bl. ex Molinier 1934

Arbuto andrachnes-Quercion cocciferae Barbero et Quézel 1979 (Cluster 4 in Figure 1, Table 1-4a, Figure 2-4a) (EVC)

Cyclamini cretici-Quercion ilicis Barbero et Quézel ex Quézel, Barbero et Akman 1993 (Cluster 4 in Figure 1, Table 1, 4b, Figure 2-4b) (EVC)

Pistacio lentisci-Rhamnetalia alaterni Rivas-Mart. 1975

Ceratonio siliquae-Pistacion lentisci Zohary et Orshan 1959 (Cluster 5 in Figure 1, Table 1-5, Figure 2-5) (EVC)

Quercetalia cocciferae Zohary 1955 *nom. corr.*

Quercion cocciferae Zohary 1955 *nom. corr.* (Cluster 6 in Figure 1, Table 1-6, Figure 2-6) (EVC)

Pinetea halepensis Bonari et Chytrý in Bonari et al. 2021

Pinetalia halepensis Biondi, Blasi, Galdenzi, Pesaresi et Vagge 2014

Pinion pineae Feinbrun 1959 (Cluster 2 in Figure 1, Table 1-2b, Figure 2-2b) (EVC)

Styraco officinalis-Pinion brutiae Bonari, Chytrý, Çoban, Kavgacı et Sağlam in Bonari et al. 2021 (Cluster 7 in Figure 1, Table 1-7a, Figure 2-7a) (notEVC)

Pinion brutiae Feinbrun 1959 (Cluster 7 in Figure 1, Table 1-7b, Figure 2-7b) (EVC)

Erico-Pinetea Horvat 1959

Erico-Pinetalia Horvat 1959 *nom. conserv. propos.*

Adenocarpo complicati-Pinion pallasianae Quézel, Barbero et Akman 1993 (Cluster 12 in Figure 1, Table 1-12, Figure 2-12) (notEVC)

Cisto laurifolii-Pinion pallasianae Akman, Barbero et Quézel ex Quézel, Barbero et Akman 1993 (Cluster 13 in Figure 1, Table 1-13, Figure 2-13) (notEVC)

Junipero-Pinetea sylvestris Rivas-Mart. 1965 *nom. invers.*

Berberido creticae-Juniperetalia excelsae Mucina in Mucina et al. 2016

Juniperion excelso-foetidissimae Em ex Matevski et al. 2010 (Cluster 16 in Figure 1, Table 1-16, Figure 2-16) (EVC)

Quercetea pubescentis Doing-Kraft ex Scamoni et Passarge 1959

Querco-Cedretalia libani Barbero et al. 1974

Abieti cilicicae-Cedrion libani Quézel, Barbero et Akman 1993 (Cluster 17 in Figure 1, Table 1-17 Figure 2-17) (notEVC)

Lonicero nummulariifoliae-Cedrion libani Quézel, Barbero et Akman 1993 (Cluster 18 in Figure 1, Table 1-18, Figure 2-18) (notEVC)

Querco vulcanicae-Ostryion carpinifoliae Kavgacı, Balpınar, Öner, Arslan, Bonari, Chytrý et Čarni *all. nov.* (Cluster 9 in Figure 1, Table 1-9, Figure 2-9) (New)

Falcario vulgaris-Quercion cerridis Kavgacı, Balpınar, Öner, Arslan, Bonari, Chytrý et Čarni *all. nov.* (Cluster 10 in Figure 1, Table 1-10, Figure 2-10) (New)

Quercetalia pubescenti-petraeae Klika 1933

Quercion macrolepidis (Zohary 1973) Kavgacı, Balpınar, Öner, Arslan, Bonari, Chytrý et Čarni *nom. nov.* (Cluster 8 in Figure 1, Table 1-8, Figure 2-8) (EVC)

Brachypodio pinnati-Betuletea pendulae Ermakov et al. 1991

Fragario vescae-Populetalia tremulae Willner et Mucina in Willner et al. 2016 nom. inval.

Fragario vescae-Populion tremulae Willner et Mucina 2016 ined. (Cluster 14 in Figure 1, Table 1-14, Figure 2-14) (EVC)

4.4 | Descriptions of the new syntaxa

Cisto salviifolii-Lavandulion stoechadis Kavgacı, Balpınar, Öner, Arslan, Bonari, Chytrý et Čarni *all. nov.*

Corresponding name: *Cisto salviifolii-Lavandulenion stoechadis* Barbero et al. 1989 *nom. inval.* (ICPN, Art. 4 and Art. 5).

Holotypus: *Salvio aramiensis-Hypericetum triquetrifolii* Barbero et Quézel ex Kavgacı, Balpınar, Arslan, Öner, Bonari, Chytrý et Čarni 2020 *ass. nov.* (holotypus of the association: Barbero & Quézel, 1989, p. 52, table 6, relevé 12).

Diagnostic species: *Cistus monspeliensis*, *Cistus salviifolius*, *Lavandula stoechas* and *Sideritis pisidica*.

Ecology: This alliance encompasses the phrygana vegetations thriving over non-carbonate bedrock in Mediterranean Turkey and adjacent parts of the Mediterranean region.

Galio floribundi-Cistion laurifolii Kavgacı, Balpınar, Öner, Arslan, Bonari, Chytrý et Čarni *all. nov.*

Holotypus: *Hyperico heterophylli-Cistetum laurifolii* Sağlam ex Kavgacı, Balpınar, Arslan, Öner, Bonari, Chytrý et Čarni *ass. nov.* (holotypus of the association: Sağlam, 2013, table 5, relevé 23).

Diagnostic species: *Acinos rotundifolius*, *Allium flavum*, *Alyssum desertorum* var. *desertorum*, *A. strigosum*, *Arabis nova*, *Bromus squarrosus*, *Bromus tectorum*, *Cistus laurifolius*, *Galium floribundum*, *Herniaria glabra*, *Holosteum umbellatum*, *Hypericum olympicum*, *Hypericum origanifolium*, *Juniperus oxycedrus*, *Linaria simplex*, *Logfia arvensis*, *Minuartia mesogitana*, *Phleum exaratum*, *Salvia tomentosa*, *Sedum pallidum*, *Silene supina* subsp. *pruinosa*, *Trifolium arvense*, *Verbascum insulare*, *Veronica grisebachii*, *Vulpia ciliata* and *Ziziphora taurica*.

Ecology: This alliance represents the supra-mediterranean garrigue communities dominated by *Cistus laurifolius* resulted from the degradation of *Pinus nigra* subsp. *pallasiana* forests.

Querco vulcanicae-Ostryion carpinifoliae Kavgacı, Balpınar, Öner, Arslan, Bonari, Chytrý et Čarni *all. nov.*

Holotypus: *Asyneumo michauxioidis-Quercetum trojanae* Ocakverdi et Çetik ex Kavgacı, Balpınar, Öner, Arslan, Bonari, Chytrý et Čarni 2020 *ass. nov.* (holotypus of the association: Ocakverdi & Çetik, 1987, table 17, relevé 53).

Diagnostic species: *Acer hyrcanum*, *Acer monspessulanum*, *Arabis caucasica*, *Asyneuma michauxioides*, *Campanula pterocaula*, *Carex divulsa*, *Cerastium fragillimum*, *Clinopodium vulgare*, *Cornus sanguinea*, *Coronilla emerus* subsp. *emeroides*, *Elymus panormitanus*, *Epipactis condensata*, *Eragrostis cilianensis*, *Erysimum goniocaulon*, *Festuca heterophylla*, *Fraxinus ornus*, *Fumaria parviflora*, *Galium lucidum*, *Geum urbanum*, *Gladiolus atroviolaceus*, *Lapsana communis*, *Laser trilobum*, *Lathyrus aureus*, *Myrrhoides nodosa*, *Opopanax hispidus*, *Ostrya carpinifolia*, *Paeonia mascula*, *Papaver apokrinomenon*, *Physospermum cornubiense*, *Quercus trojana*, *Rubia rotundifolia*, *Scaligeria hermonis*, *Serratula grandifolia* and *Silene alba* subsp. *eriocalycina*.

Ecology: This alliance represents the supra-mediterranean *Ostrya carpinifolia*, *Quercus trojana* and *Quercus vulcanica*-dominated forests occurring at precipitation-rich sites with low temperature seasonality and deep soils in the central and western Taurus Mountains.

Falcario vulgaris-Quercion cerridis Kavgacı, Balpınar, Öner, Arslan, Bonari, Chytrý et Čarni *all. nov.*

Holotypus: *Trifolio physodis-Quercetum cerridis* Tatlı et al. 2005 (holotypus in Tatlı et al., 2005, table 5, relevé 33).

Diagnostic species: *Agrimonia eupatoria*, *Bunium ferulaceum*, *Carex divulsa*, *Cephalorrhynchus tuberosus*, *Cerastium fragillimum*, *Coronilla varia*, *Crataegus monogyna*, *Falcaria vulgaris*, *Festuca valesiaca*, *Galium verum*, *Lathyrus digitatus*, *Papaver apokrinomenon*, *Prunus spinosa*, *Quercus cerris* and *Trifolium physodes*.

Ecology: This alliance represents the supra-mediterranean *Quercus cerris*-dominated forests at deep soils along whole Mediterranean Turkey.

Quercion macrolepidis (Zohary 1973) Kavgacı, Balpınar, Öner, Arslan, Bonari, Chytrý et Čarni *nom. nov.*

Synonym: *Quercion macrolepidis anatolicum* Zohary 1973 (Zohary, 1973: p. 516) *nom. illeg.* (ICPN, Art. 34a).

Holotypus: *Quercetum macrolepidis anatolicum* Zohary 1973. Zohary (1973, p. 516, 517) described the association *Quercetum macrolepis anatolicum* and indicated four relevés published by Schwarz (1936b, p. 392) as stands of this association. The name of the association is illegitimate (ICPN, Art. 34a) but can be used as a type of the alliance (ICPN, Art. 17). As Zohary (1973, p. 517) mentioned the species composition of relevé 67 in Schwarz (1936b, p. 392), it can be understood as the holotypus of the association. Nevertheless, we propose a new name *Quercetum macrolepidis* (Zohary 1973) Kavgacı, Balpınar, Öner, Arslan, Bonari, Chytrý et Čarni *nom. nov.*, based on the basionym *Quercetum macrolepidis anatolicum* Zohary 1973 (Zohary, 1973: 516) *nom. illeg.* (ICPN, Art. 34a).

Diagnostic species (Zohary, 1973): *Quercus ithaburensis* subsp. *macrolepis*.

Ecology: Sparse meso- and supra-mediterranean oak forests dominated by *Quercus ithaburensis* subsp. *macrolepis* and *Quercus infectoria* on different bedrocks of the Eastern Mediterranean.

5 | CONCLUSIONS

We collected vegetation data on forest and shrubland in Mediterranean Turkey and present the first synthetic overview of their classification. We classified 21 vegetation types at the alliance level. Among them, four alliances were described as new. Twelve of them were already recognized in EuroVegChecklist, while the other five alliances were formally described earlier but not included in EuroVegChecklist. This confirms that the Mediterranean vegetation of Turkey has a close similarity to the vegetation of the European part of the Mediterranean. However, the vegetation of Mediterranean Turkey also shows some differences because of its location in the eastern Mediterranean, the influence of the Irano-Turanian flora and almost 30% endemicity. A future integration of Turkish syntaxa into EuroVegChecklist would be desirable for a better understanding of European and Mediterranean vegetation.

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AUTHOR CONTRIBUTIONS

AK and AČ conceived of the idea; AK, NB, HHÖ and MA prepared the data set; AK and AČ performed the statistical analyses; AK and AČ wrote the manuscript with essential contributions of MC, GB, NB and MA.

DATA AVAILABILITY STATEMENT

Vegetation-plot data used in this study are available in the Forest Vegetation Database of Turkey, a part of the European Vegetation

Archive (EVA). They can be obtained upon request from the first author.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

Appendix S1. Vegetation data sources of each alliance

Appendix S2. Full synoptic table of the vegetation types at the alliance level in Mediterranean Turkey

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