

THE VEGETATION OF KARLIK MOUNTAIN IN SOUTHWESTERN TURKEY

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Abstract

The southwestern region of Turkey has different vegetation, site conditions, and biodiversity. There are many phytosociological studies conducted in this region. The vegetation map of Europe has been completed, but the vegetation map of our country has not been completed yet. Our study, which was carried out to identify the vegetation structure of Karlık Mountain (Yatağan/Muğla), is original as no phytosociological research has been realized before in the research area. Our study aims to contribute to the syntaxonomic studies of the southwestern region of Turkey. Karlık Mountain is under threat due to the active activity of grazing and mining. For this reason, it is important to determine and protect the vegetation structure of the area. The altitude of Karlık Mountain is between 800-1400 m. The Braun - Blanquet approach was used in the vegetation applied between 2019 - 2020 and analyzed using JUICE classification, and NMDS ordination. As a result of the study, four plant associations belonging to two different vegetation types new to science were identified. Detected vegetation types are forest, and steppe vegetation. The forest vegetation consist of *Sileno odontopetalo - Pinetum brutiae* Aytepe ass. nova, *Scabioso polykratis - Pinetum pallasianae* Aytepe ass. nova, and *Potentillo rectae - Juniperetum foetidissimatis* Aytepe ass. nova. The steppe vegetation consists of *Fumano arabicae - Astragaletum condensati* Aytepe ass. nova.

Keywords: Juice, Muğla, NMDS, Ordination, Phytosociology, Vegetation

Introduction

The Mediterranean Basin is one of the global biodiversity hotspots (Myers *et al.*, 2000). According to Terzioğlu *et al.*, (2012) its topography, microclimate diversity, and location at the junction of three different phytogeographical (Mediterranean, Euro -Siberian, and Irano - Turanian) regions, Turkey is one of the most important centers in the world in terms of plant biodiversity that hosts a great number of habitats.

Plant communities, which make up the overall vegetation structure of a region, are composed of plants that are dispersed over comparable environmental conditions. Determining plant biodiversity, comprehending ecological differences, and evaluating habitat diversity all depend on the definition of plant communities (Blassi & Burrascano, 2013).

The local - scale plant communities must be identified in order to conduct extensive vegetation analysis research. In this perspective, it is evident that research on plant communities is extensive and well - researched worldwide, particularly in Europe (Chytrý *et al.*, 2016). In actuality, extensive vegetation databases for European flora have been created and thorough classifications have been completed, all based on local investigations. These datasets have been used to map the distribution of plant communities at the alliance level and to virtually finish classify habitats in Europe (Chytrý *et al.*, 2020; Preislerová *et al.*, 2022).

In the 1970s, Turkey saw a rise in plant sociology studies, partly due to the involvement of foreign academics. However, vegetation studies in our country were able to gain momentum in the following years. Research on Turkey's vegetation was mostly carried out by French scientists such as Quezel, Barbero, and Gehu. With the involvement of

Turkish academics who were interested in the topic, these numbers rose in the next years, and Turkey's vegetation sciences saw a significant advancement (Quézel *et al.*, 1992; Ketenoğlu *et al.*, 2010; Bergmeier *et al.*, 2018). Large - scale datasets, including the Forest Vegetation Database of Turkey (Kavgacı *et al.*, 2021), the oak forest vegetation in Turkey (Uğurlu *et al.*, 2012), and the Western Euxine forest vegetation of Turkey (Çoban & Willner, 2019), were generated and evaluated based on these investigations.

Many phytosociological studies, for example, Géhu *et al.*, 1988; Vural *et al.*, 1995; Özel, 1996; Tatlı *et al.*, 2005; Tsiourlis *et al.*, 2009; Kavgacı *et al.*, 2021, have been practiced out in and around the southwestern region of Turkey. Nevertheless, Karlık Mountain, which is located in the high plant biodiversity region of Muğla province (SW Turkey), has not been well investigated. Determining the vegetative diversity of this mountain is essential to comprehending the richness and diversity at the regional level. Our aim in this study is (a) to determine the main vegetation types of Karlık Mountain, which stands out as an original study since no phytosociological study has been done before (b) to contribute to the literature in terms of identifying the syntaxonomy of vegetation types (c) to integrate ensure our results into the European vegetation classification system.

Materials and Methods

Study area: The research area, whose altitude is between 800-1400 m, is within the boundary of the city of Yatağan (Muğla) and is located in southwestern Turkey. The map of the research area was prepared with the map obtained from the Yatağan Forest Processing Directorate and Anon., (2023) (Fig. 1). The study area is located within the

Mediterranean phytogeographic borders. Karlık Mountain is surrounded by Karadiken District in the west, Çırpı District in the east, Çukuröz District in the northeast, Bencik Mountain and Keçili District in the northwest, and Kavak Mountain in the southwest.

The bedrock of the research area is to be composed of marble, phyllite, and schist rocks from the Upper Paleozoic and Mesozoic periods (Kayan, 1979). Geological formations on Karlık Mountain consist of marble, phyllite, and schist units (Şenel & Bilgin, 1997). There are colluvial, limeless brown, brown, and red - brown Mediterranean soils that exist in the study area (Anon., 1998). According to Akman (1990), the seen climate in the area, where the precipitation regime is winter – spring – autumn - summer, is a less rainy and warm variant of the Mediterranean climate. Climatic data from the Muğla meteorological station were used (Anon., 2018).

Sampling, numerical analysis and typification: To determine the vegetation of Karlık Mountain, 25 quadrats were taken between 2019 - 2020. Braun Blanquet approach was used and an appropriate size and a sufficient number of sample areas were defined from each plant formation. In addition to general topographic information, each plot's protocol includes information on altitude, inclination, aspect, total and individual layer vegetation cover, and a list of all vascular plants, with each species assigned a cover value based on the five - degree Braun - Blanquet scale. TWINSpan in JUICE (Tichý, 2002) was used for the numerical classification of quadrats. Sorensen dissimilarity coefficient - based modified TWINSpan hierarchical classification was used (Roleček *et al.*, 2009). Using ordination approaches, the categorization results were shown in NMDS. A fidelity measure in the JUICE was used to identify the diagnostic species of the approved clusters (Tichý,

2002). Subjectively, 0.50 was chosen as the phi value threshold at which a species may be classified as diagnostic (Chytrý *et al.*, 2002). Accepted as constant species were those that occurred 50% of while in each plant community, and dominant species were those that covered more than 25% of at least 10% of the vegetation plots in each community. The view of the associations on Karlık Mountain in ordination is given Flora of Turkey (Davis, 1965 - 1982; Davis *et al.*, 1988) and Turkey Plants List (Güner, 2012) were preferred for the classification of plants; The European vegetation classification system (Mucina *et al.*, 2016) was used to evaluate syntaxonomic units; the fourth edition of the International Code of Plant Sociological Nomenclature (ICPN; Theurillat *et al.*, 2021) was benefited for the classification and naming of associations.

Results

Karlık Mountain, which contains forest, and steppe vegetation types with four associations (Fig. 2), belongs to the meso - Mediterranean and supra - Mediterranean belts.

Cluster 1 *Fumana arabica* - *Astragalus condensatus* community

The dominant species of this association, which shows improvement in the maquis vegetation openings at an altitude of 1346 - 1387 m, are *Astragalus condensatus* and *Ebenus barbigera*. The association, which occurs in the non-calcareous brown soil whose formation is made of marble rocks, generally spreads in northwest, southeast, and southwest ways and on an area slope of 5-45°; the general coverage of this association, which consists of one vertical layer: (a) herb layer, coverage 60-95%, height 0.4-1 m, varies from 60 to 95%.

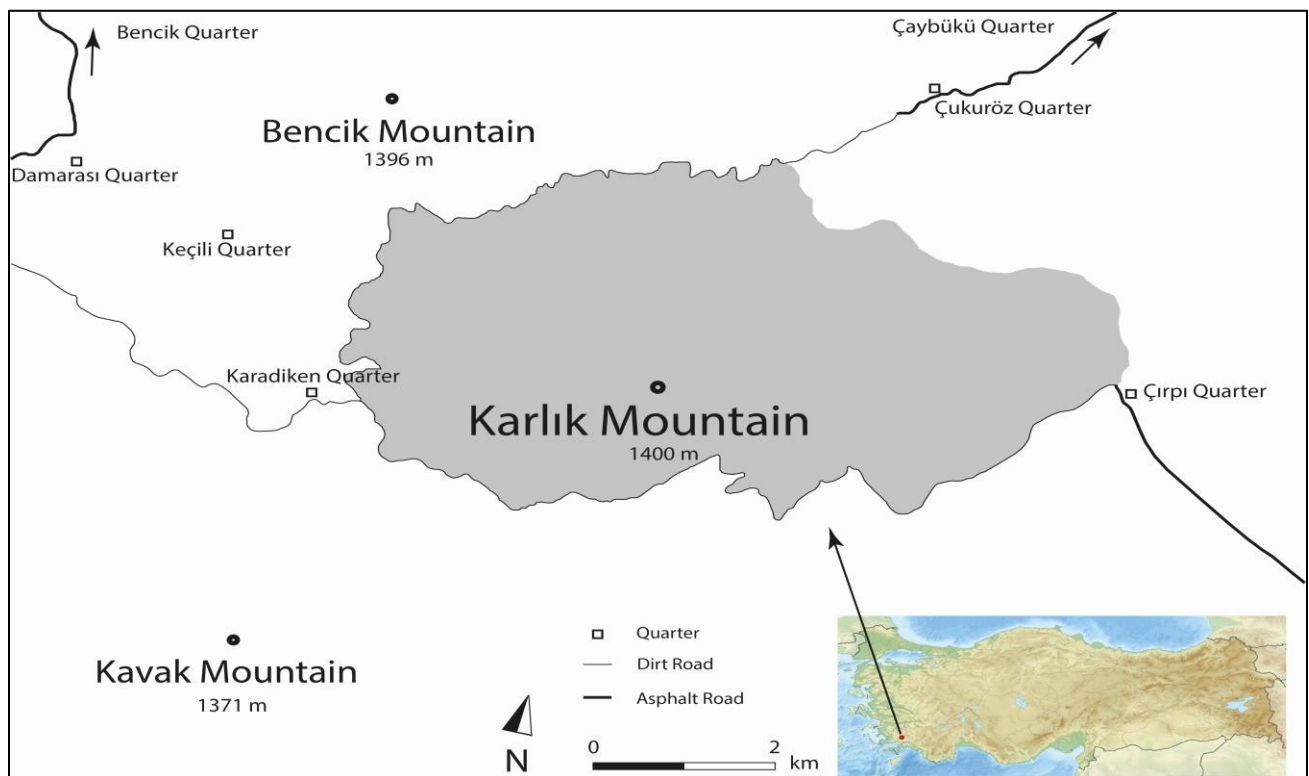


Fig. 1. Map of the research area.

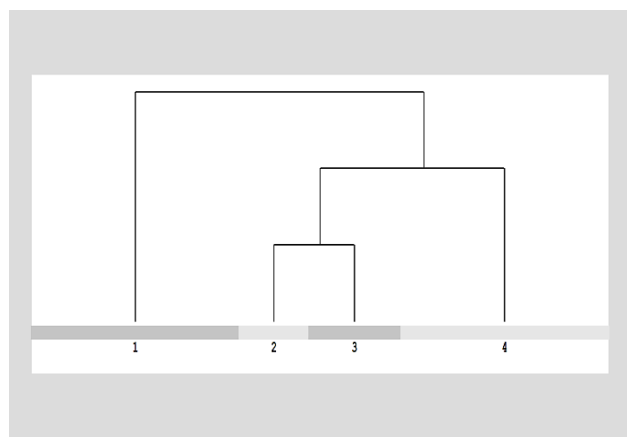


Fig. 2. TWINSpan dendrogram of Karlik Mountain plant association analysis (1. *Fumana arabica* - *Astragalus condensatus* community 2. *Potentilla recta* - *Juniperus foetidissima* community 3. *Scabiosa polykratis* - *Pinus nigra* subsp. *pallasiana* community 4. *Silene odontopetala* - *Pinus brutia* var. *brutia* community)

Diagnostic species: *Astragalus condensatus*, *Centaurea cariensis* subsp. *niveotomentosa*, *Ebenus barbigera*, *Euphorbia taurinensis*, *Fumana arabica*, *Helichrysum compactum*, *Inula heterolepis*, *Onosma mitis*, *Phleum boissieri*, *Picris pauciflora*, *Sedum album*, *Sedum lydium*, *Thymus cilicicus*, *Tordylium apulum*

Constant species: *Astragalus condensatus*, *Bromus squarrosus*, *Bromus sterilis*, *Centaurea cadmea*, *Cerastium brachypetalum* subsp. *roeseri*, *Ebenus barbigera*, *Festuca valesiaca*, *Fumana arabica*, *Legousia speculum-veneris*, *Ornithogalum neurostegium*, *Phleum boissieri*, *Poa bulbosa*, *Sedum lydium*, *Thymus cilicicus*, *Verbascum pinardii*

Dominant species: *Astragalus condensatus*, *Ebenus barbigera*

Cluster 2 *Potentilla recta* - *Juniperus foetidissima* community

This community prefers the 1364 - 1387 m range on Karlik Mountain. It generally occurs a west, south aspect and a slope of 5°. This association is found in limeless brown soil, which is made up of marble rocks; this association is comprised of three vertical layers with a general coverage ranging from 80 to 90%: (a) tree layer, varies from 60-90%, a height of 3-7 m; (a) shrub layer, varies from 10-20%, a height of 0.5-0.6 m; (b) herb layer, varies from 80-90%, height 0.6-1 m.

Diagnostic species: *Acantholimon acerosum* var. *acerosum*, *Aegilops caudata*, *Aegilops geniculata*, *Aegilops triuncialis*, *Alyssum desertorum*, *Alyssum murale* subsp. *murale*, *Asyneuma limoniifolium* subsp. *pestalozzae*, *Bromus squarrosus*, *Bromus tectorum*, *Centaurea aphrodisaea*, *Cruciata taurica*, *Cyanus segetum*, *Dianthus zonatus* var. *zonatus*, *Erysimum carium*, *Geranium dissectum*, *Henrardia persica* var. *persica*, *Iberis carica*, *Juniperus foetidissima*, *Lamium amplexicaule*, *Lamium garganicum* subsp. *striatum* var. *striatum*, *Onopordum acanthium*, *Ornithogalum neurostegium*, *Phleum boissieri*, *Phlomis fruticosa*, *Poa*

bulbosa, *Potentilla recta*, *Ranunculus arvensis*, *Scandix stellata*, *Sherardia arvensis*, *Silene italica*, *Tragopogon dubius*, *Valeriana dioscoridis*, *Valerianella balansae*, *Valerianella echinata*, *Verbascum glomeratum*

Constant species: *Aegilops geniculata*, *Alyssum desertorum*, *Aubrieta deltoidea*, *Bromus squarrosus*, *Bromus sterilis*, *Cyanus segetum*, *Juniperus foetidissima*, *Juniperus oxycedrus*, *Legousia speculum-veneris*, *Ornithogalum neurostegium*, *Phillyrea latifolia*, *Phleum boissieri*, *Poa bulbosa*, *Potentilla recta*, *Quercus coccifera*, *Scandix stellata*, *Silene italica*, *Valeriana dioscoridis*, *Verbascum glomeratum*

Dominant species: *Juniperus foetidissima*

Cluster 3 *Scabiosa polykratis* - *Pinus nigra* subsp. *pallasiana* community

This community prefers the 1319 - 1344 m range on Karlik Mountain. It generally occurs a northwest, southwest, west aspect and a slope of 30-45°. This association is found in limeless brown soil, which is made up of marble rocks; this association's overall coverage ranges from 60 to 70% and is divided into three vertical layers: (a) tree layer: which varies from 60-70%, a height of 15-25 m; (b) shrub layer, varies from 15-30%, a height of 2-5 m; (c) herb layer, varies from 20-60%, height 0.5-1 m.

Diagnostic species: *Allium stamineum*, *Alyssum smyraneum*, *Anthemis cretica* subsp. *pontica*, *Asyneuma limoniifolium* subsp. *limoniifolium*, *Aubrieta deltoidea*, *Galium floribundum* subsp. *floribundum*, *Juniperus foetidissima*, *Lactuca tuberosa*, *Lamium garganicum*, *Lotononis genistoides*, *Minuartia juniperina*, *Origanum hypericifolium*, *Pilosella piloselloides* subsp. *piloselloides*, *Pinus nigra* subsp. *pallasiana*, *Quercus cerris*, *Quercus coccifera*, *Scabiosa polykratis*, *Tragopogon papposa* var. *longirostris*

Constant species: *Alyssum smyraneum*, *Anthemis cretica* subsp. *pontica*, *Asyneuma limoniifolium* subsp. *limoniifolium*, *Aubrieta deltoidea*, *Briza humilis*, *Cistus creticus*, *Dactylis glomerata* subsp. *hispanica*, *Festuca valesiaca*, *Juniperus foetidissima*, *Juniperus oxycedrus*, *Lamium garganicum*, *Origanum hypericifolium*, *Phillyrea latifolia*, *Pinus nigra* subsp. *pallasiana*, *Poa bulbosa*, *Quercus coccifera*, *Scabiosa polykratis*

Dominant species: *Pinus nigra* subsp. *pallasiana*

Cluster 4 *Silene odontopetala* - *Pinus brutia* var. *brutia* community

This association is distribution between 859-1247 m in Karlik Mountain. It generally prefers a northwest, southwest, south, west, east, north aspect and a slope of 20-45°. *Silene odontopetala* - *Pinus brutia* var. *brutia* community exists on the limeless brown soil, formed by marble, and phyllite rocks; the association, which means the cover of this association varies from 60 to 85%, occurs in three vertical layers: (a) tree layer: range of 60-85%, a height of 15-30 m; (b) shrub layer, range of 1-70%, height 0.1-6 m; (c) herb layer, range of 5-85%, height 0.5-1.5 m.

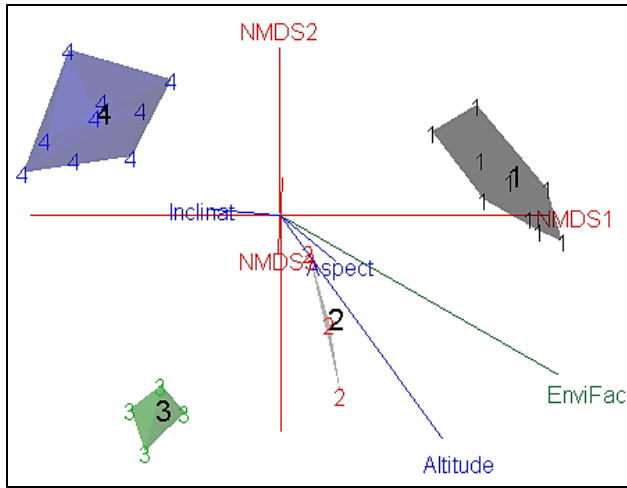


Fig. 3. NMDS ordination of the communities (1. *Fumana arabica* - *Astragalus condensatus* community 2. *Potentilla recta* - *Juniperus foetidissima* community 3. *Scabiosa polykratis* - *Pinus nigra* subsp. *pallasiana* community 4. *Silene odontopetala* - *Pinus brutia* var. *brutia* community).

Diagnostic species: *Anthemis cretica* subsp. *albida*, *Arabis verna*, *Asparagus acutifolius*, *Asteriscus spinosus*, *Campanula lyrata* subsp. *lyrata*, *Crepis sancta*, *Crepis setosa*, *Dactylis glomerata* subsp. *hispanica*, *Doronicum orientale*, *Euphorbia rigida*, *Galium heldreichii*, *Galium spurium* subsp. *ibicinum*, *Geranium purpureum*, *Ipomoea sagittata*, *Lathyrus aphaca* subsp. *pseudoaphaca*, *Lathyrus aphaca* var. *affinis*, *Lens ervoides*, *Linaria pelisseriana*, *Myosotis ramosissima*, *Origanum onites*, *Pilosella hoppeana* subsp. *magyarica*, *Pinus brutia* var. *brutia*, *Quercus ithaburensis* subsp. *macrolepis*, *Salvia bracteata*, *Silene odontopetala*, *Sonchus oleraceus*, *Trifolium glanduliferum*, *Trifolium grandiflorum*, *Trifolium tomentosum*, *Veronica cymbalaria*, *Vicia lathyroides*

Constant species: *Arabis verna*, *Cistus creticus*, *Crucianella latifolia*, *Dactylis glomerata* subsp. *hispanica*, *Euphorbia rigida*, *Galium spurium* subsp. *ibicinum*, *Geranium purpureum*, *Myosotis ramosissima*, *Pinus brutia* var. *brutia*, *Quercus coccifera*, *Salvia bracteata*, *Silene odontopetala*, *Sonchus oleraceus*, *Stipa bromoides*, *Trifolium grandiflorum*, *Trifolium tomentosum*, *Vicia lathyroides*

Dominant species: *Cistus creticus*, *Pinus brutia* var. *brutia*, *Quercus coccifera*.

Ordination

Species with a frequency value of less than 25% were omitted in all associations. We see that vegetation types are clearly formed with the change in ecological conditions in the research area, which find out by four plant associations (Fig. 3). For example, features such as height and rock type stand out at first (Fig. 4). *Silene odontopetala*-*Pinus brutia* var. *brutia* community between 859-1247 m, *Scabiosa polykratis* - *Pinus nigra* ssp. *pallasiana* community is between 1319-1344 m, *Fumana arabica* - *Astragalus condensatus* community is between 1346-1387 m, and *Potentilla recta* - *Juniperus foetidissima* community community is between 1364-1387 m. It can be said that *Silene odontopetala*-*Pinus*

brutia var. *brutia* community has a high number of species because it is found on marble and phyllite rocks, and other units are found only on marble rocks. According to the number of species in the forest community, the richest community is *Silene odontopetala* - *Pinus brutia* var. *brutia* community, and the poorest community is *Scabiosa polykratis* - *Pinus nigra* ssp. *pallasiana* community. *Fumana arabica*-*Astragalus condensatus*, and *Potentilla recta* - *Juniperus foetidissima* communities have less number of species. In addition, it was observed that the study area was heavily grazed during the field studies.

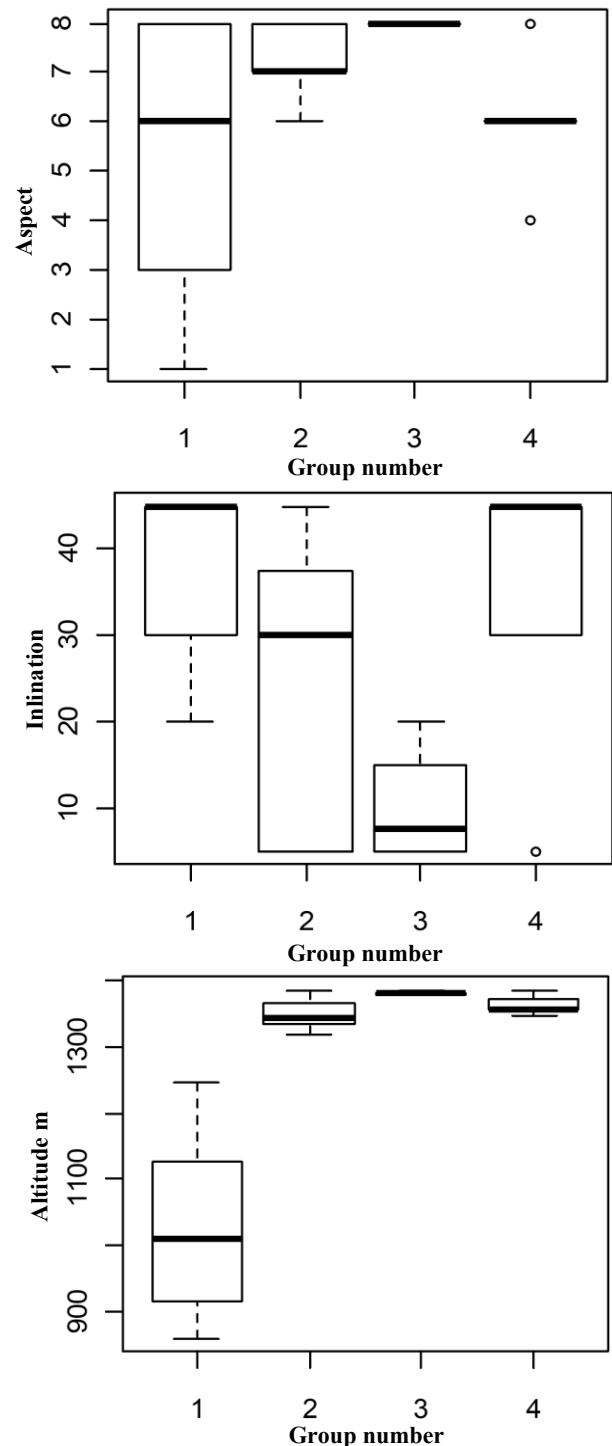


Fig. 4. Box – whisker diagrams of topographic variables for each community in Karlık Mountain, whose group numbers are given in Figs. 2 and 3.

Discussion

Karlık Mountain, which is placed on the mezo – Mediterranean and supra-Mediterranean belts is established between 800 - 1400 m. According to the result of the analysis forest, and steppe vegetation was described in the research area. Topographic factors have a significant influence on the identification of the communities in the Mediterranean Region (Fontaine *et al.*, 2007; Kavgacı *et al.*, 2010a,b,c). In the analysis, it is seen that topographic factors are effective in the formation of the associations. *Silene odontopetala* - *Pinus brutia* var. *brutia* community is classified as an upper - altitude red pine forest because of found on 859-1247 m in Karlık Mountain. Therefore, this community was classified under *Styraco officinalis* - *Pinion brutiae*. There are many studies on the classification of the red pine forest in Anatolia and around the research area.

Fumana arabica - *Astragalus condensatus* community is very close to the high mountain steppe vegetation in terms of floristics and physiognomy. There are many studies on steppe vegetation, whose character type is *Astragalus condensatus*. Balpınar *et al.*, 2017 and Musarella *et al.*, 2020 studies are there in this research. The Sivrihisar Mountains *Astragalus condensatus* dominated community (Balpınar *et al.*, 2017) has a very different floristic composition than this community, and it is classified as *Globulario lumose* - *Astragaletum condensati* ass. nova hoc loco. *Thymo samii* - *Astragaletum condensati* Musarella, Brullo, and Giusso ass. nov. hoc loco (Musarella *et al.*, 2020) are localized on the limestone surface and at 110 m altitude. *Fumana arabica* - *Astragalus condensatus* community is different from these associations because of existing of floristic structure, physiognomy, and ecology. According to the result of the study *Fumano arabicae* - *Astragaletum condensati* Aytepe ass. nova (Holotypus: Table 1; relevé: 23) was concluded that respectively included in *Phlomido armeniaca* - *Astragalion microcephali*, *Onobrychido armenae* - *Thymetalia leucostomi*, and *Astragalo* - *Brometea*.

Juniperus foetidissima, a tall shrub or tree up to 20 m tall, is an Eastern Mediterranean element taxon (Davis *et al.*, 1965-1982). These vegetation represents coniferous, which is *Juniperus foetidissima*. There are many associations described regarding *Juniperus foetidissima*. *Junipero foetidissimae* - *Juniperetum excelsae* ass. nova Türe *et al.* 2005 is classified the alliance Quercion anatolicae of the class Quercetea pubescentis. This association is described in north of Turkey (Türe *et al.*, 2005) and demonstrate floristic differentiation from the *Potentilla recta* - *Juniperus foetidissima* community. There are many associations are described around this area by foreign scientists. *Sorbo orbiculatae* - *Juniperetum foetidissimae* Barbero & Quezel ex Brullo, Giusso & Guarino ass. nova, hoc loco, *Pterocophalo perennis* - *Juniperetum foetidissimae* Georgiadis & Dimopoulos ex Brullo, Giusso & Guarino ass. nova, *Abieto borisii-regis* - *Juniperetum foetidissimae* Brullo, Giusso Sr Cuakino ass. nova (Brullo *et al.*, 2001). *Potentilla recta* - *Juniperus foetidissima* community is differ from these associations resulting from their floristic compositions, characteristic species, floristic structure, physiognomy, and ecology. For these reasons, this community is considered a new association. *Potentillo rectae* - *Juniperetum foetidissimatis* Aytepe ass. nova (Holotypus: Table 1; relevé: 20) was found that accordingly included in *Juniperion excelso* - *foetidissimae*, *Berberido creticae* - *Juniperetalia excelsae*, *Junipero* - *Pinetea sylvestris*.

Pinus nigra covers an area of about 4.2 million hectares (Akkemik *et al.*, 2011) and it is one of the characteristic species of the transitional climatic and vegetation zone between sea - influenced areas (Mediterranean and Black Sea regions) and continental areas (Inner Anatolia) (Saatçioğlu, 1976). *Pinus nigra* subsp. *pallasiana* exists in the Balkans, South Carpathian mountains, Crimean, Turkey, Cyprus, and Syria (Bussotti, 2002). One of the subspecies of European black pine, the Anatolian black pine (*Pinus nigra* J.F. Arnold subsp. *pallasiana* (Lamb.) Holmboe var. *pallasiana*) occurs naturally as a widespread mid - altitude species in the Taurus and the western and northern Anatolian Mountains of Turkey *Pinus nigra* subsp. *pallasiana* forests in Turkey have been classified into two distinct alliances in phytosociological studies: *Adenocarpocomplicati* - *Pinion pallasianae* in Mediterranean Turkey and *Cisto laurifolii* - *Pinion pallasianae* in the Black Sea region and central Turkey (Akman, 1995; Ketenoğlu *et al.*, 2010). Bergmeier *et al.*, (2018) classified *Pinus nigra* - dominated forests under *Adenocarpocomplicati* - *Pinion pallasianae* in the Aegean and southern Mediterranean regions of Turkey.

The Anatolian black pine's northland distributions in southwest Turkey are represented by Özel (1999) and Doğan & Özen (2002). These associations demonstrate floristic differentiation from the *Scabiosa polykratis* - *Pinus nigra* subsp. *pallasiana* community, and develop in the limeless brown forest soil and limeless brown soil, respectively. On the other hand, *Scabiosa polykratis* - *Pinus nigra* subsp. *pallasiana* community was found in the brown forest soils. *Lathyro laxiflori* - *Pinetum pallasianae* ass. nova hoc loco R. Tzonev *et al.*, 2018 is determined in Bulgaria (Tzonev *et al.*, 2018). *Scabiosa polykratis* - *Pinus nigra* subsp. *pallasiana* community is different from *Lathyro laxiflori* - *Pinetum pallasianae* ass. nova hoc loco R. Tzonev *et al.*, 2018. Due to the distance of these studies from the study area, the difference in diagnostic species, and ecology differences, *Pinus nigra* ssp. *pallasiana* - *Scabiosa polykratis* community is defined as a new association. *Scabiosa polykratis* - *Pinetum pallasianae* (Holotypus: Table 1; relevé: 14) was determined that each was included in, *Adenocarpocomplicati* - *Pinion pallasianae*, *Erico* - *Pinetalia*, *Erico* - *Pinetea*.

Aetheorhiza-*Pinetum brutiae* and *Phlomido bourgaei*-*Pinetum brutiae* are described by Vural *et al.*, (1995). *Junipero phoeniceae* - *Pinetum brutiae* Akman *et al.* 1998 is determined in Bodrum (Akman *et al.*, 1998). However, these communities are distinct floristically and reflect the ranges of the species (*Pinion brutiae*) in the Eu - and thermo - Mediterranean regions. Other studies from higher elevation in the surrounding regions of Southern Mediterranean Turkey include *Phlomido leucophractae* - *Pinetum brutiae* in Antalya Gulf (Kurt *et al.*, 2015), *Glycyrrhizo asymetricae* - *Pinetum brutiae*, and *Asparago acutifoli* - *Pinetum brutiae* found in Finike province (Antalya) (Karaköse & Terzioğlu, 2021). Additional research has also been conducted in Turkey's northern Mediterranean region (Ketenoğlu *et al.*, 2010). Compared to the Turkish pine woods on Karlık Mountain, the floristic makeup of each of these groups is distinct. This community is defined as a new association due to these reasons. *Sileno odontopetala* - *Pinetum pallasianae* Aytepe ass. nova (Holotypus: Table 1; relevé: 7) classified as respectively; *Styraco officinalis* - *Pinion brutiae*, *Pinetalia halepensis*, and *Pinetea halepensis*.

Table 1. Vegetation table of the Karlik Mountain. Group numbers match community numbers, and the vegetation plots are arranged in accordance with the cluster analysis shown in Figure 2: (1. *Fumano arabicae - Astragaletum condensati* 2. *Potentillo rectae - Juniperetum foetidissimatis* 3. *Scabioso polykratis - Pinetum pallasianae* 4. *Sileno odontopetalae - Pinetum brutiae*).

Quadrat number	19	15	17	18	16	24	25	22	23	13	21	20	11
Group number	1	1	1	1	1	1	1	1	1	2	2	2	3
Altitude (m)	1356	1380	1382	1385	1378	1358	1346	1387	1374	1387	1364	1366	1332
Size of quadrat (m²)	25	25	25	25	25	25	25	25	25	256	256	256	900
Exposure (°)	NW	NW	NW	NW	NW	SW	SW	SE	SW	S	W	W	NW
Inclination (°)	5	10	5	5	20	45	30	45	45	5	5	5	45
Coverage total (%)	80	90	90	95	75	70	60	60	60	80	80	90	60
Coverage of trees (%)		-	-	-	-	-	-	-	-	60	65	90	60
Height of trees (m)		-	-	-	-	-	-	-	-	3	6	6-7	20
Coverage of shrubs (%)		-	-	-	-	-	-	-	-	20	15	10	15
Height of shrubs (m)		-	-	-	-	-	-	-	-	0.6	0.6	0.5	3
Coverage of herbs (%)	80	90	90	95	75	70	60	60	60	80	80	90	30
Height of herbs (m)	0.7	0.7	0.8	0.85	0.8	0.4	0.4	0.5	0.4	0.6	1	0.6	0.5
<i>Fumano arabicae-Astragaletum condensati</i>													
<i>Fumana arabica</i>	1	.	1	1	.	1	1	1	1	.	.	.	.
<i>Astragalus condensatus</i>	.	4	3	4	3	.	.	.	.	.	.	.	.
<i>Sedum lydium</i>	.	1	1	.	1	1	.	.	.	.	.	.	.
<i>Thymus cilicicus</i>	3	.	.	.	2	2	2	3	2	.	1	.	.
<i>Sedum album</i>	.	.	.	.	.	1	.	1	1	.	.	.	.
<i>Helichrysum compactum</i>	.	.	.	.	.	1	.	2	1	.	.	.	.
<i>Picris pauciflora</i>	1	.	.	.	.	.	.	1	1	.	.	.	.
<i>Ebenus barbigera</i>	3	.	.	.	.	3	3	3	3	1	.	.	.
<i>Centaurea cariensis</i> subsp. <i>niveotomentosa</i>	.	1	.	.	3	.	.	.	.	.	.	.	.
<i>Tordylium apulum</i>	.	.	.	.	.	.	.	1	1	.	.	.	.
<i>Euphorbia taurinensis</i>	.	.	.	.	.	.	1	1	.	.	.	.	.
<i>Inula heterolepis</i>	.	.	.	.	.	2	.	.	1	.	.	.	.
<i>Onosma mitis</i>	.	.	.	.	.	r	.	.	r	.	.	.	.
<i>Potentillo rectae-Juniperetum foetidissimatis</i>													
<i>Juniperus foetidissima</i>	.	.	.	.	.	.	.	.	.	3	3	3	1
<i>Potentilla recta</i>	.	.	.	.	.	.	.	.	.	r	r	.	.
<i>Verbascum glomeratum</i>	.	.	.	.	.	.	.	.	.	r	1	.	.
<i>Alyssum desertorum</i>	.	.	.	.	.	.	1	.	.	.	1	1	.
<i>Scandix stellata</i>	.	.	1	.	.	.	.	.	.	.	1	1	.
<i>Valeriana dioscoridis</i>	.	.	.	.	.	.	.	.	.	.	1	1	.
<i>Aegilops geniculata</i>	1	.	.	1	.	.	.	.	.	.	1	1	.
<i>Cyanus segetum</i>	.	.	.	.	.	.	.	.	.	.	1	1	.
<i>Centaurea aphrodisea</i>	.	.	.	.	.	.	.	.	.	1	.	.	.
<i>Dianthus zonatus</i> var. <i>zonatus</i>	.	.	.	.	.	.	.	.	.	1	.	.	.
<i>Geranium dissectum</i>	.	.	.	.	.	.	.	.	.	.	1	.	.
<i>Lamium amplexicaule</i>	.	.	.	.	.	.	.	.	.	.	.	r	.
<i>Alyssum murale</i> subsp. <i>murale</i>	.	.	.	.	.	.	.	.	.	.	1	.	.
<i>Erysimum carium</i>	.	.	.	.	.	.	.	.	.	1	.	.	.
<i>Asyneuma limonifolium</i> subsp. <i>pestalozzae</i>	.	.	.	.	.	.	.	.	.	1	.	.	.
<i>Onopordum acanthium</i>	.	.	.	.	.	.	.	.	.	1	.	.	.
<i>Bromus tectorum</i>	.	.	.	.	.	.	.	.	.	1	.	.	.
<i>Iberis carica</i>	.	.	.	.	.	.	.	.	.	1	.	.	.
<i>Henrardia persica</i> var. <i>persica</i>	.	.	.	.	.	.	.	.	.	.	.	1	.
<i>Valerianella balansae</i>	.	.	.	.	.	.	.	.	.	.	.	1	.
<i>Cruciata taurica</i>	.	.	.	.	.	.	.	.	.	.	1	.	.
<i>Phlomis fruticosa</i>	.	.	.	.	.	.	.	.	.	.	1	.	.
<i>Aegilops caudata</i>	.	.	.	.	.	.	.	.	.	.	1	.	.
<i>Ranunculus arvensis</i>	.	.	.	.	.	.	.	.	.	.	.	r	.
<i>Valerianella echinata</i>	.	.	.	.	.	.	.	.	.	.	.	r	.
<i>Lamium garganicum</i> subsp. <i>striatum</i> var. <i>striatum</i>	.	.	.	.	.	.	.	.	.	.	.	1	.
<i>Sherardia arvensis</i>	.	.	.	.	.	.	.	.	.	.	.	1	.
<i>Silene italica</i>	.	.	.	.	.	.	.	1	1	.	1	1	.
<i>Ornithogalum neurostegium</i>	.	2	1	1	2	.	.	.	.	1	1	.	.
<i>Bromus squarrosus</i>	.	1	.	r	2	1	.	2	.	.	1	r	.
<i>Poa bulbosa</i>	r	r	r	r	2	r	.	.	r	r	r	r	.
<i>Acantholimon acerosum</i> var. <i>acerosum</i>	.	.	.	1	.	.	.	.	.	1	.	.	.
<i>Tragopogon dubius</i>	.	.	.	.	.	.	.	.	.	.	r	.	.
<i>Aegilops triuncialis</i>	.	.	.	.	.	.	.	.	.	1	.	.	.
<i>Scabioso polykratis-Pinetum pallasianae</i>													
<i>Scabiosa polykratis</i>	.	.	.	.	.	.	.	.	.	.	.	.	2
<i>Pinus nigra</i> subsp. <i>pallasiana</i>	.	.	.	.	.	.	.	.	.	.	.	.	3
<i>Origanum hypericifolium</i>	.	.	.	.	.	.	.	.	.	.	.	.	2

[illegible]

Quadrat number	10	12	14	9	8	7	6	5	4	3	2	1
Group number	3	3	3	4	4	4	4	4	4	4	4	4
Altitude (m)	1344	1319	1337	1247	1203	859	910	916	942	1126	1032	1010
Size of quadrat (m ²)	900	900	900	900	900	900	900	900	900	900	900	900
Exposure (°)	W	NW	SW	E	E	S	S	W	N	NW	N	SW
Inclination (°)	30	45	30	20	45	45	45	30	30	30	45	45
Coverage total (%)	70	60	70	70	60	80	85	80	85	60	60	80
Coverage of trees (%)	70	60	70	60	60	80	60	70	85	60	60	80
Height of trees (m)	25	15	25	30	20	15	15	25	30	25	25	30
Coverage of shrubs (%)	25	20	30	70	60	10	30	1	15	40	30	10
Height of shrubs (m)	5	2	3	6	4	5	4-5	0.1	3	5	5	3
Coverage of herbs (%)	20	20	60	30	40	80	85	80	5	40	50	30
Height of herbs (m)	0.6	1	0.5	0.5	1.5	1	1	1.5	0.6	1	1	1
<i>Fumano arabicae-Astragaletum condensati</i>												
<i>Fumana arabica</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Astragalus condensatus</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Sedum lydium</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Thymus cilicicus</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Sedum album</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Helichrysum compactum</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Picris pauciflora</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ebenus barbigera</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Centaurea cariensis</i> subsp. <i>niveotomentosa</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Tordylium apulum</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Euphorbia taurinensis</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Inula heterolepis</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Onosma mitis</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Potentillo rectae-Juniperetum foetidissimatis</i>												
<i>Juniperus foetidissima</i>	1	2	1	.	.	.	.	.	.	.	.	.
<i>Potentilla recta</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Verbascum glomeratum</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Alyssum desertorum</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Scandix stellata</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Valeriana dioscoridis</i>	.	.	.	1	.	.	.	.	.	.	.	.
<i>Aegilops geniculata</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cyanus segetum</i>	.	.	.	.	.	.	.	2	.	1	.	.
<i>Centaurea aphrodisaea</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Dianthus zonatus</i> var. <i>zonatus</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Geranium dissectum</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lamium amplexicaule</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Alyssum murale</i> subsp. <i>murale</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Erysimum carium</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Asyneuma limonifolium</i> subsp. <i>pestalozzae</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Onopordum acanthium</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Bromus tectorum</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Iberis carica</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Henrardia persica</i> var. <i>persica</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Valerianella balansae</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cruciata taurica</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Phlomis fruticosa</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Aegilops caudata</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ranunculus arvensis</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Valerianella echinata</i>	.	.	.	.	.							

Quadrat number	10	12	14	9	8	7	6	5	4	3	2	1
Group number	3	3	3	4	4	4	4	4	4	4	4	4
<i>Prunus domestica</i>	.	.	.	.	.	.	.	.	.	.	1	.
<i>Lathyrus cicera</i>	.	.	.	.	1	.	.	.	.	.	.	.
<i>Daphne gnidioides</i>	.	.	.	2	.	.	.	.	.	.	.	.
<i>Legousia falcata</i>	.	.	.	.	1	.	.	.	.	.	.	.
<i>Teucrium scordium</i> subsp. <i>scordium</i>	.	.	.	.	2	.	.	.	.	.	.	.
<i>Gladiolus italicus</i>	.	.	.	.	2	.	.	.	.	.	.	.
<i>Scrophularia pinardii</i>	.	.	.	.	.	.	.	.	.	.	.	r
<i>Urospermum picroides</i>	.	.	.	.	.	r	.	.	.	.	.	.
<i>Acanthus spinosus</i>	.	.	.	.	.	.	.	.	.	.	.	1
<i>Quercus aucheri</i>	.	.	.	.	.	.	.	.	.	.	.	1
<i>Cardamine graeca</i>	.	.	.	.	.	.	.	.	.	.	.	r
<i>Oenanthe pimpinelloides</i>	.	.	.	.	.	.	.	.	.	.	.	r
<i>Ornithogalum cuspidatum</i>	.	.	.	.	.	.	.	.	.	.	2	.
<i>Saponaria pinetorum</i>	.	.	.	.	.	.	.	.	.	1	.	.
<i>Silene conica</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Leontodon tuberosus</i>	.	.	.	.	.	.	.	1	.	.	.	.
<i>Petrorrhagia dubia</i>	.	.	.	.	.	.	.	1	.	.	.	.
<i>Ornithopus compressus</i>	.	.	.	.	.	.	.	1	.	.	.	.
<i>Muscari armeniacum</i>	.	.	.	.	r	.	.	.	.	.	.	.
<i>Picnomon acarna</i>	.	.	.	.	.	.	.	.	.	1	.	.
<i>Filago eriocephala</i>	.	.	.	1	.	.	.	.	.	.	.	.
<i>Prunus spinosa</i>	.	.	.	.	.	.	.	.	2	.	.	.
<i>Galium verum</i> subsp. <i>verum</i>	.	.	.	.	1	.	.	.	.	.	.	.
<i>Amygdalus communis</i>	.	.	.	.	.	.	.	.	2	.	.	.
<i>Holosteum umbellatum</i>	.	.	.	.	1	.	.	.	.	.	.	.
<i>Limodorum abortivum</i>	.	.	.	.	.	.	2	.	.	.	.	.
<i>Scandix iberica</i>	.	.	.	.	.	.	.	.	.	1	1	.
<i>Torilis nodosa</i>	.	.	.	.	1	1	.	.	.	.	.	.
<i>Cynosurus echinatus</i>	.	.	.	.	.	.	1	2	1	.	.	.
<i>Trifolium campestre</i>	.	.	.	.	1	1	.	2	.	.	.	.
<i>Stipa bromoides</i>	.	.	r	.	1	.	.	r	r	.	.	1
<i>Sedum amplexicaule</i>	.	.	.	.	1	.	.	1	.	.	.	.
<i>Verbascum pinardii</i>	.	.	.	.	1	.	.	.	.	1	1	.
<i>Cephalanthera rubra</i>	1	.	.	.	.	.	.	.	1	.	.	1
<i>Festuca jeanpertii</i>	r	.	.	1	.	.	.	.	.	.	2	.
<i>Salvia fruticosa</i>	2	.	.	1	1	.	.	.	.	.	.	.
<i>Cistus creticus</i>	1	.	1	.	.	4	4	3	.	.	.	1
<i>Milium vernale</i> subsp. <i>vernale</i>	.	.	.	.	.	.	1	1	.	1	.	.
<i>Milium pedicellare</i>	.	.	.	.	.	.	.	.	.	.	1	1
<i>Legousia pentagonia</i>	.	.	.	.	.	.	.	1	.	1	.	.
<i>Briza humilis</i>	.	.	r	.	1	.	.	.	.	1	.	1
<i>Orlaya daucooides</i>	r	.	.	.	.	1	1	1	.	.	.	.
<i>Ziziphora capitata</i>	.	.	.	.	1	.	.	.	.	.	.	.
<i>Cotoneaster nummularius</i>	1	.	.	.	.	.	.	.	.	.	1	.
<i>Tulipa cinnabarina</i> subsp. <i>toprakii</i>	1	.	.	.	.	.	.	.	.	.	1	.
<i>Paronychia mughlai</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Velezia pseudorigida</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Astragalus oxytropifolius</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Fritillaria carica</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Silene conica</i>	.	.	.	.	.	.	.	.	.	.	1	.
<i>Scutellaria orientalis</i> subsp. <i>pinnatifida</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Phlomis carica</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Centaurea urvillei</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ziziphora tenuior</i>	.	.	.	.	.	.	.	.	.	.	.	.
<i>Phillyrea latifolia</i>	r	.	1	3	2	.	.	.	.	.	.	.
<i>Bromus sterilis</i>	.	.	.	.	.	.	.	2				

The syntaxa determined are as follows:

Syntaxonomical scheme

Pinetea halepensis Bonari et Chytrý in Bonari *et al.*, 2021
Pinetalia halepensis Biondi, Blassi, Galdenzi, Pesaresi et Vagge 2014
Pinion brutiae Feinbrun 1959
Sileno odontopetalae - *Pinetum brutiae*
 Aytepe ass. nova
Erico-Pinetea Horvat 1959
Erico-Pinetalia Horvat 1959 nom. conserv. propos.
Adenocarpo - *Pinion pallasianae* Quézel, Barbero et Akman 1993
Scabioso polykratis - *Pinetum pallasianae*
 Aytepe ass. nova
Junipero-Pinetea sylvestris
Berberido creticae - *Juniperetalia excelsae*
Juniperion excelso - *foetidissimae*
Potentillo rectae - *Juniperetum foetidissimatis* Aytepe ass. nova
Astragalo - *Brometetea* Quézel 1973
Onobrychido armenae - *Thymetalia leucostomi*
 Akman, Ketenoğlu, Quézel 1985
Phlomido armeniaca - *Astragalion microcephali*
 Akman, Ketenoğlu, Quézel et Demirörs 1984
Fumano arabicae - *Astragaletum condensati*
 Aytepe ass. nova

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