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The *Daphne sericea* Vahl vegetation in the Gargano promontory (Southern Italy)

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Abstract
The vegetation with *Daphne sericea* Vahl occurring in the eastern sector of the Gargano Promontory (southern Italy) is presented here. *Daphne sericea* is an evergreen and nano-phanerophyte species occurring in the central and eastern part of the European Mediterranean basin. In Italy, it is present in some Tyrrhenian coastal areas, whereas along the Adriatic coasts it occurs in the Gargano area and in Tremiti Islands. In the Gargano area, *Daphne sericea* occurs mainly in the eastern part of the promontory where it is found on formations of Majolica rich in lists and chert nodules. The phytosociological study of this area allowed us to describe a new association of microforest dominated by *Juniperus oxycedrus* subsp. *oxycedrus,* named *Daphno sericeae-Juniperetum oxycedri* differentiated into two subassociations: *oleetosum sylvestris* and *quercetosum virgilianae*.
Daphne sericea is the characteristic species of the new holm-oak association named *Anemono apenninae-Quercetum ilicis* that occurs even in the new subassociation *quercetosun dalechampii*, indicating the transition to the mesophilus and acidophilus formations of deciduous forests.
Daphne sericea is also abundant in the undergrowth of two deciduous forest formations where it helps to differentiate two new subassociations which are *daphnetosum sericeae* of the association *Cyclamino hederifolii-Quercetum virgilianae* and *daphnetosum sericeae* of the association *Physospermo verticillati-Quercetum cerris*. In addition to the forest coenoses indicated, it was possible to recognize an association of nanophanerophytic vegetation named *Daphno sericeae-Cistetum monspeliensis*. The syntaxonomical scheme of the studied vegetation is proposed.
In the conclusions, the high colonizing ability of *Daphne sericea* is highlighted, indeed, it is able to participate in such diverse plant communities in a geomorphological enclave so particular because of the characteristics of the substrate.

Key words: *Cisto cretici-Micromerietea julianae, Daphne sericea*, Gargano, Italy, phytosociology, *Quercetea ilicis, Querco-Fagetea*.

Introduction

Daphne sericea is an evergreen species; it is a nano-phanerophyte that can reach about 2 m in height. It occurs in the central and eastern part of the European Mediterranean basin (Italy, Greece and Turkey). In Italy, its distribution range is discontinuous, the species occurs in some coastal Tyrrhenian areas between Tuscany and Campania and then in the archipelago of Egadi Islands in Marettimo (Sicily). In the Apennines, it is sporadically present in the group of Aurinci and in Abruzzo mountains. Further in the south, it occurs along the Adriatic coasts in the Gargano peninsula and in Tremiti Islands (Di Pietro, 2001).

In the area of distribution investigated in this study, *Daphne sericea* occurs at the edge of the woods forming more or less thick shrublands with rock roses (*Cistus* sp.pl.) and participates in the constitution of micro forests of *Juniperus oxycedrus* subsp. *oxycedrus* and enters in thick holm-oak woods sometimes with deciduous tree species such as *Quercus pubescens* and *Ostrya carpinifolia*. It also occurs in the undergrowth of woods dominated by *Ostrya carpinifolia* or *Quercus cerris*. The aim of this research is (i) the description of the plant communities in which *Daphne sericea* takes part with regards to microbioclimate and geomorphological conditions and (ii) to better define the autoecology and synecology of this species.

Materials and methods

Study area

The study area includes the distribution range of *Daphne sericea* in the Gargano Promontory, and it is focused in the south-eastern part (Fig. 1).

The area where *Daphne sericea* occurs is localized on the basin deposits of the Apulian Platform, represented by formations of Majolica. The geology of this area is formed by white limestone bedrock in thin layers with lists and nodules of chert (Bosellini & Morsilli, 2001). Probably, these elements of chert, where the rocks are particularly rich of them, can give rise to some kind of alterations giving origin to soils with acid reaction, as already seen in other forest types such as turkey-oak woods occurring in Foresta Umbra (Biondi *et al*., 2008).

The study area bioclimate, according to Rivas-Martínez *et al*. (2011), is almost homogeneous: Mediterranean pluviseasonal oceanic bioclimate, upper meso-mediterranean thermotype and upper dry ombrotype horizon. Only a few samples of relevés carried out at higher altitude and in inner areas have a lower subhumid ombrotype horizon (Pesaresi *et al*., 2014).

The study area is part of a bioclimatic context, that of the Gargano peninsula, characterized by a very strong gradient: going from the coast towards the inner part, only in 10 km the bioclimate changes from the upper

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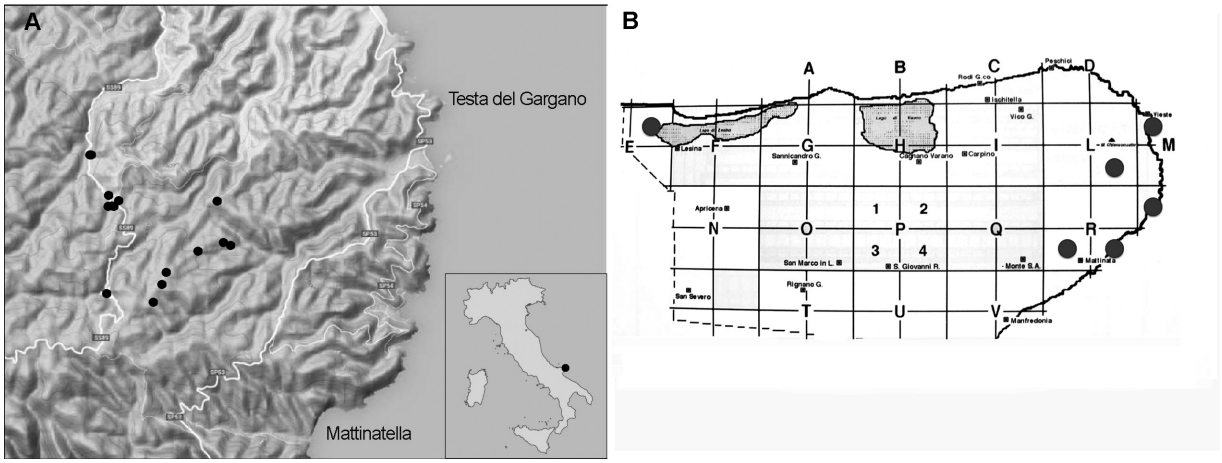

Fig. 1 – (a) The study area focused in the south-eastern sector of the Gargano promontory (black dots are the phytosociological relevés localised by GPS). (b) Range of distribution of *Daphne sericea* in the Gargano Peninsula (from Biscotti, 2007).

thermomediterranean (Mediterranean macrobioclimate) to the lower supratemperate thermotype (Temperate macrobioclimate sub Mediterranean variant).

Vegetation analysis

The vegetation analysis was carried out according to the phytosociological method of the Sigmatist school of Zurigo-Montpellier, proposed by Braun-Blanquet (1964) and subsequent amendments (Rivas-Martínez, 2005; Géhu, 2006; Biondi, 2011; Blasi *et al*., 2011; Blasi & Frondoni, 2011; Pott, 2011). For the description of new syntaxa, the International Code of Phytosociological Nomenclature (Weber *et al*., 2000) has been followed. The syntaxonomical scheme refers to the prodrome of Italian vegetation (Biondi *et al*., 2014) which is available online in Italian language at the Italian Botany Society's webpage (http://www.prodromo-vegetazione-italia.org/introduzione).

Environmental data

The study area is homogeneous from a bioclimatic and geologic point of view but shows differences in terms of meso-microbioclimate due to various morphologic and topographic site conditions (Fig. 1).

For each phytosociological survey (geolocalized by GPS) the 'Topografhic Position Index' (TPI) (Guisan *et al*., 1999) and the solar radiation (for the whole year and for the three summer months) were calculated from a digital elevation model (DEM) of 20 meters resolution. Several studies have shown the importance of insolation in determining the distribution of vegetation (eg Franklin, 1995; Guisan & Zimmerman, 2000; Guisan *et al*., 1999; Biondi *et al*., 2011).

TPI are calculated at each cell of the DEM by calculating the difference between the elevation of the cell and the mean elevation of a specified neighborhood (in this case we used radius of 60m, 100m and 200m to calculate TPI60, TPI100 and TPI200) around that cell. Positive TPI values represent high sector of slopes and ridges. Negative TPI values represent low sector of slopes and valleys. TPI values near zero are either flat areas (where the slope is near zero) or areas of constant slope (where the slope of the point is significantly greater than zero).

The solar radiation was calculated by the "Point Solar Radiation" tool (ESRI ArcGIS 9.3). The point solar radiation tool calculates the total amount of radiation for a particular location considering the topography as a major factor that determines the spatial variability of insolation received at different locations. Variation in elevation, orientation (slope and aspect), and shadows cast by topographic features are considered in the insolation calculation.

Thus, for the ecological study of the *Daphne sericea* vegetation the following environment variables have been taken into account: Altitude (ALT), Annual solar radiation (SY), Summer solar radiation (SS), TPI with different radius (TPI60, TPI100, TPI200), slope (SLO) and the fisionomy of the vegetation (W, levels: WS = forest ecosystem; WN = micro woods and/or shrublands).

Statistical analysis

For the classification and the identification of the phytocoenosis, a cluster analysis (unweighted pair group method with arithmetic mean, chord distance) on the vegetation data matrix with abundance values converted to the Van deer Mareel scale (1979) was made.

To show the major trends in the floristic variation, the Non-Metric Multidimensional Scaling ordering (NMDS) on the chord space was carried out.

Finally, to analyze the vegetation-environment relationships and identify the majors meso-microbioclimatic and topographic drivers of the vegetation, the Redundancy Data Analysis (RDA) on the covariance species matrix chord-transformed (Legendre & Gallagher, 2001) was carried out. The adjusted R-square

(Peres-Neto *et al*., 2006) and the significance of the RDA model, by permutation-tests (Legendre *et al*., 2011) were calculated. To detect and avoid the collinearity problems or linear dependencies among the environmental variables, the Variance Inflaction Factor (VIF) was used.

Results and discussion

Vegetation analysis
Cluster analysis and NMDS ordering

Four main groups (clusters) are clearly highlighted by the cluster analysis dendrogram (Fig. 2A).

Groups II and III represent the forest vegetation communities, while groups I and IV the micro woods, shrublands and garrigues vegetation.

The cluster I refers to mesophilus forests occurring in the same landscape system but in particular site conditions. The first of the two relevés forming the cluster

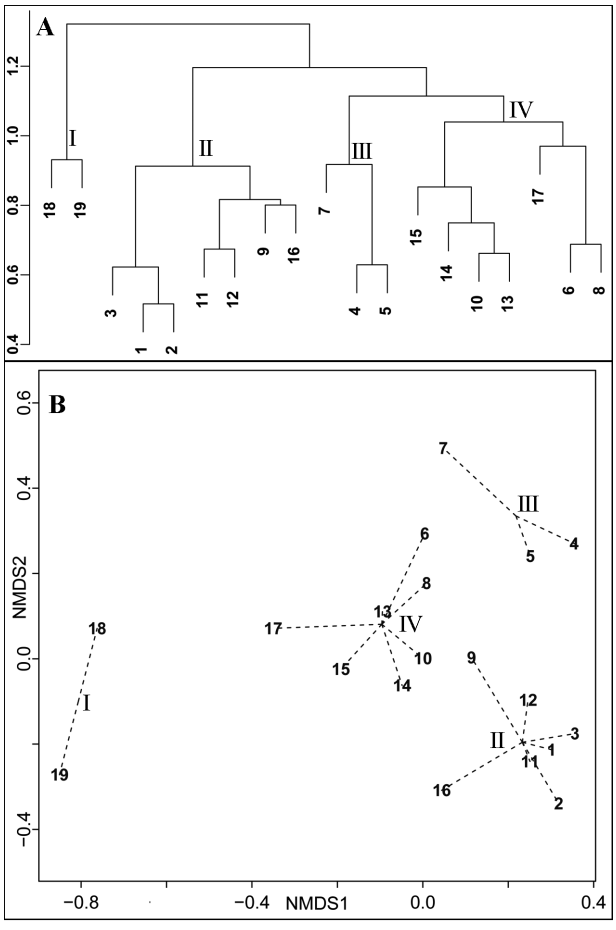

Fig 2 - Dendrogram of cluster analysis (A) and NMDS biplot (stressplot = 0.11) of chord dissimilarity matrix of the *Daphne sericea* vegetation abundance data. (B) Dashed lines represents the clusters derived from cluster analysis. Roman numbers are the four main groups of cluster analysis.

(rel. n.18 in fig. 1,2,3), was carried out in a ravine rock wood that lies at the base of the slope. It is an *Acer neapolitanum* forest wih *Ostrya carpinifolia, Quercus cerris, Q. ilex* and *Ilex aquifolium* probably to be referred to an hygrophilus and acidophilus rock variant of the association *Pulmonario apenninae-Aceretum neapolitani* described for the north side of Gargano on flat terraces. Further investigations could lead to describe an original syntaxon. The second relevé (rel. n.19 in fig. 1,2,3) refers to a meso-hygrophilus and subacidophilus forest dominated by *Carpinus betulus* and *Acer campestre* that grows on small terraces along the slope. Considering the physionomy, it is similar to the association *Doronico orientalis-Carpinetum betuli* floristically impoverished. Also in this case, further investigation would be useful to the possible description of a new syntaxon.

Cluster II refers to microwoods with *Juniperus oxycedrus* subsp. *oxycedrus* and *Daphne sericea* referred to the new association, later described in the text, named *Daphno sericeae-Juniperetum oxycedri* which shows three different subassociations as the dendrogram also suggests.

The cluster III brings together the most thermophilus relevés made by *Daphne sericea* and *Erica arborea* (ril. 7 in fig. 1,2,3) and the post fire garrigue with *Daphne sericea* and *Cistus monspeliensis* (ril. 4 and 5) of the association of new description *Daphno sericeae-Cistetum monspeliensis*.

Cluster IV brings together different types of woods. The relevé n. 15 is an acidophilus forest of Turkey oak which is referred to the new subassociation *daphnetosum sericeae* of the association *Physospermo verticillati-Quercetum cerris* as will be described later. The relevé n. 14 represents the new subassociation *daphnetosum sericeae* of the association *Cyclamino hederifolii-Quercetum virgilianae*. The remaining relevés of cluster IV are referred to a new holm oak association called *Anemono apenninae-Quercetum ilicis*. Two relevés belonging to this association, relevés n. 10 and n. 13 in the dendrogram of figure 2A are closer to those of *Quercus virgiliana* woods.

These groups are clearly separated even in the NMDS plot (Fig. 2B). NMDS1 axis represents the trend of floristic variation between the forest vegetation and the scrubs and scrubland linked to TPI and then the edaphic moisture. NMDS2 axis seems associated to insolation and therefore to the thermicity of the sites.

Vegetation-environment relationship
RDA analysis

The environmental variables selected by VIF are: ALT, SLO, TPI60, S and W.

The RDA has produced 5 canonical axes whose eigenvalues explain about 47% (R2 = 0.47, adjusted R2

= 0.27) of the floristic variance. The variance explained, as expected, is not very high given the large number of variables (about 160 species x 17 phytosociological relevés).

The first two canonical axes RDA1 and RDA2 represent 70% of the explained variance (Fig. 3).

Permutation tests have shown a high significance for the global RDA model (p = 0.001 with 999 permutations) and for the first two axes (p = 0,001 with 999 permutations). Then the RDA model showed a clear relationship between the floristic variation and the environmental variables.

The axes RDA1 is mainly related to the variable W while the RDA2 axis is related to SLO, TPI60, ALT and inversely related to S.

In the RDA distance triplot (Fig. 3) all significant results of the RDA analysis are showed. Furthemore, the most significant species that linearly covary and that characterize the different vegetation types described below are highlighted .

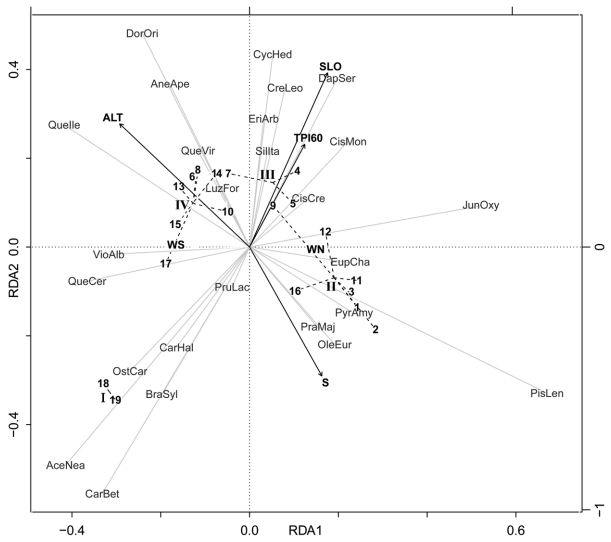

Fig. 3 - RDA distance triplot of the chord-transformed *Daphne sericea* vegetation abundance data constrained by SLO (Slope), TPI60 (Topgraphic position index with radius of 60m), S (Summer solar radiation), ALT (Altitude), WS (forest ecosystem) and WN (micro woods and/or shrublands). Dashed lines represent the groups (I, II, III, IV) derived from cluster analysis. Species legend: AceNea - *Acer neapolitanum*; AneApe - *Anemone apennina*; BraSyl - *Brachypodium sylvaticum*; CarHal - *Carex hallerana*; CarBet - *Carpinus betulus*; CisCre - *Cistus creticus* subsp. *creticus*; CisMon - *Cistus monspeliensis*; CreLeo - *Crepis leontodontoides*; CycHed - *Cyclamen hederifolium*; DapSer - *Daphne sericea*; DorOri - *Doronicum orientale*; EriArb - *Erica arborea*; EupCha - *Euphorbia characias*; JunOxy - *Juniperus oxycedrus*; LuzFor - *Luzula forsteri*; OleEur - *Olea europaea* var. *sylvestris*; OstCar - *Ostrya carpinifolia*; PisLen - *Pistacia lentiscus*; PraMaj - *Prasium majus*; PruLac - *Prunella laciniata*; PyrAmy - *Pyrus amygdaliformis*; QueCer - *Quercus cerris*; QueIle - *Quercus ilex*; QueVir - *Quercus virgiliana*; SilIta - *Silene italica*; VioAlb - *Viola alba* subsp. *dehnhardtii*.

DAPHNO SERICEAE-JUNIPERETUM OXYCEDRI ass. nova *hoc loco* (*Holotypus*: rel. 1, Tab. 1)

On calcareous subtratum, in the steepest and highest parts of the sides (high values of SLO and TPI60), on dry soils and near the sea (at lower altitude), in the most sunny areas (high values of S), a high maquis has been detected, in some cases with a shape of micro-wood, about 10 m high, dominated by *Juniperus oxycedrus* constantly in relation with *Daphne sericea* (Fig. 3). This micro-wood has been indicated with the name *Daphno sericeae-Juniperetum oxycedri*. In addition to *Juniperus oxycedrus* and to *Daphne sericea*, *Phillyrea media* is the third characteristic species, whereas *Pyrus amygdaliformis, Euphorbia characias* and *Cyclamen hederifolium* are differential species of the association.

The association is represented by two new subassociations: the thermophilus *oleetosum sylvestris* (linked to most sunny areas with higher TPI and SLO, label 1,2,3 in Fig. 2,3) and the subassociation *quercetosum virgilianae* (label 9,16 in in Fig. 2,3) that indicates the transition towards more mesophilus (lower TPI end S) communities dominated by deciduous species.

DAPHNO SERICEAE-JUNIPERETUM OXYCEDRI ass. nova *oleetosum sylvestris* subass. nova *hoc loco* (*Holotypus*: rel. 4, Tab.1)

The community occurs on an olive grove abandoned for many years and derived from grafting of wild olive. The substrate is rather poor, rich in limestone clasts on the surface.

Differential species of this subassociation are the following thermophilus species: *Olea europea* var. *sylvestris*, *Prasium majus, Clematis flammula, Arisarum vulgare* and *Lonicera implexa*.

DAPHNO SERICEAE-JUNIPERETUM OXYCEDRI ass. nova *quercetosum virgilianae* subass. nova *hoc loco* (*Holotypus*: rel. 7, Tab. 1)

The differential species of this subassociation are: *Quercus virgiliana, Viola alba* subsp. *dehnhardtii, Brachypodium sylvaticum, Acer campestre, Hedera helix, Sorbus torminalis, Prunella laciniata* and *Carpinus orientalis*. This subassociation indicates the transition towards the association *Cyclamino hederifolii-Quercetum virgilianae* in the subassociation *daphnetosum sericeae* that is described as follow in the text.

In the south-eastern part of Abruzzo region, in the intermontane area of Capestrano, Peligna, Fucino and Navelli basins (central Apennines) the association *Chamaecytiso spinescentis-Juniperetum oxycedri* Pirone & Cutini 2001 has been described with the su-

Tab. 1 - Comparison among the phytosociological relevés of the new association *Daphno sericeae-Juniperetum oxycedri* ass. nova *hoc loco* and those of the subassociation *daphneetosum sericeae* of the association *Chamaecytiso spinescenti-Juniperetum oxycedri* Pirone & Cutini 2001.

Relevé number	1*	2	3	4**	5	6	7***	8	9	10	11	12	13	14	15	16	17	18	
Rel. n. in fig. 1,2,3	11	12	2	1	3	9	16	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	
Altitude (m a.s.l.)	379	337	360	392	331	517	385	610	390	380	400	520	430	370	410	740	750	740	
Exposure	SE	WSW	SE	S-SW	SE	ENE	ENE	NE	W	W	WSW	-	WSW	SW	WSW	W	W	W	
Inclination (°)	30	30	20	20	10	20	20	20	20	20	20	-	15	25	25	35	40	35	
Area (m2)	200	300	500	200	50	100	90	50	25	16	15	16	50	16	20	30	21	40	
Coverage (%)	100	100	100	100	100	100	85	100	100	100	95	100	80	80	75	70	95	65	
H veg. (m)	2.5	2.5	8.5	3.5	9.5	10.7	10.5	1	1,5	1,4	2	2,5	1	0,5	0,5	1,8	2,4	1,2	Presences
Charact. and diff. species of the association																			
Juniperus oxycedrus L.	4.5	5.5	4.5	2.3	2.3	3.3	4.5	4	5	5	4	3	3	1	1	1	2	.	17
Daphne sericea Vahl	2.2	3.4	2.3	3.4	2.3	4.5	4.5	2	2	1	2	2	+	3	2	2	1	2	18
Phillyrea media L.	3.3	3.3	3.4	3.3	4.4	2.2	3.3	.	.	.	.	.	.	.	.	.	.	.	7
Cyclamen hederifolium Aiton	+.2	2.3	+.2	2.3	2.2	2.2	+	.	.	.	.	.	.	.	.	.	.	.	7
Pyrus amygdaliformis Vill.	1.2	.	1.2	1.2	1.2	+	.	.	.	.	.	.	.	.	.	.	.	.	5
Euphorbia characias L.	+	+	.	1.2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	4
Diff. species of the subass. *oleetosum sylvestris*																			
Olea europaea L. var. sylvestris	.	.	2.2	1.2	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Prasium majus L.	.	.	1.2	1.2	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Lonicera implexa Aiton	1.2	.	1.2	1.2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	4
Arisarum vulgare Targ.-Tozz.	.	.	1.2	2.3	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Diff. species of the subass. *quercetosum virgilianae*																			
Quercus virgiliana (Ten.) Ten.	.	.	.	.	.	+.2	+.2	.	.	.	.	.	.	.	.	.	.	.	2
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	.	.	.	.	.	+.2	1.2	.	.	.	.	.	.	.	.	.	.	.	2
Brachypodium sylvaticum (Hudson) Beauv.	.	.	+.2	.	.	+.2	2.2	.	.	.	.	.	.	.	.	.	.	.	3
Acer campestre L.	.	.	.	.	.	+	+.2	.	.	.	.	.	.	.	.	.	.	.	2
Hedera helix L.	.	.	.	.	.	+.2	+.2	.	.	.	.	.	.	.	.	.	.	.	2
Sorbus torminalis (L.) Crantz (pl)	.	.	.	.	.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	1
Prunella laciniata (L.) L.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1
Carpinus orientalis Miller	.	.	.	.	.	.	+.2	.	.	.	.	.	.	.	.	.	.	.	1
Charact. and diff. species of the ass. *Chamaecytiso spinescenti-Juniperetum* and of the all. *Cytision sessilifolii*																			
Lonicera etrusca Santi	.	.	.	.	.	.	.	+	1	+	1	+	+	1	1	+	.	+	10
Chamaecytisus spinescens (Presl) Rothm.	.	.	.	.	.	.	.	1	.	1	1	.	2	+	.	1	1	1	8
Osyris alba L.	+	.	.	.	.	.	.	.	2	1	.	1	2	.	.	1	2	2	8
Cistus creticus L. ssp. creticus	+.2	.	.	.	.	1.2	.	.	+	+	+	.	+	.	+	.	1	.	8
Quercus pubescens Willd.	.	.	.	.	.	.	.	+	+	.	1	.	.	+	1	.	+	1	7
Sedum rupestre L.	.	.	.	.	.	.	.	+	+	+	+	.	1	.	+	.	.	.	6
Bromus erectus Hudson	.	.	.	.	.	.	.	.	1	+	2	+	.	1	1	.	.	.	6
Phillyrea angustifolia L.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	+	.	+	5
Coronilla emerus L. ssp. emeroides (Boiss. et Spruner) Hayek	.	.	.	.	.	.	.	.	+	.	.	.	.	1	.	.	1	1	4
Spartium junceum L.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	1	.	.	.	2
Cytisus sessilifolius L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	2
Rosa canina L. sensu Bouleng.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1
Charact. and diff. species of the order *Pistacio-Rhamnetalia alaterni*																			
Rubia peregrina L.	+	1.2	2.2	1.2	2.3	1.2	1.2	.	+	.	+	+	.	+	+	.	.	.	12
Pistacia lentiscus L.	2.3	1.2	3.4	4.5	4.4	1.2	+	.	.	.	.	.	.	.	.	.	.	.	7
Allium subhirsutum L.	.	.	1.1	1.1	2.3	.	+	.	.	.	.	.	.	.	.	.	.	.	4
Rhamnus alaternus L.	.	.	1.2	.	2.2	.	.	.	.	.	.	.	.	.	.	.	.	+	3
Rhamnus saxatilis Jacq. ssp. infectorius (L.) P. Fourn.	+.2	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	3
Melica arrecta O. Kuntze	.	1.1	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Smilax aspera L.	.	.	.	1.2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Erica arborea L.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Arbutus unedo L.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1
Charact. and diff. species of the class *Quercetea ilicis*																			
Asparagus acutifolius L.	1.1	+	2.2	1.2	2.3	+	+.2	+	1	1	.	1	.	+	+	.	+	+	15
Quercus ilex L.	2.2	1.2	1.2	2.3	2.3	2.3	+	.	+	+	2	.	+	1	1	.	2	.	14
Clematis flammula L.	.	.	+	1.2	1.2	.	.	+	.	.	+	.	+	1	+	+	+	+	11
Fraxinus ornus L.	+.2	1.2	.	.	1.1	.	.	+	.	.	2	+	.	+	.	1	1	+	10
Carex hallerana Asso	1.2	2.3	2.2	2.2	2.3	2.2	3.3	.	+	1	.	.	.	.	.	.	.	.	9
Pistacia terebinthus L.	1.2	1.2	.	.	2.3	.	.	+	.	.	.	1	+	.	.	+	.	+	8
Tamus communis L.	.	.	.	1.2	2.3	+	.	.	.	.	.	.	.	.	.	.	.	.	3
Festuca exaltata C. Presl	.	2.3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Rosa sempervirens L.	.	2.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Pinus halepensis Miller	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Cyclamen repandum S. et S.	.	.	.	1.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Asplenium onopteris L.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Other species																			
Geranium purpureum Vill.	.	+	1.2	.	1.2	1.1	.	.	.	.	.	.	.	.	.	.	.	.	4
Scabiosa columbaria L.	.	.	.	.	.	.	.	.	1	+	.	.	.	+	1	.	.	.	4
Teucrium chamaedrys L.	1.2	.	+.2	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	3
Oenanthe pimpinelloides L.	.	+.2	.	.	1.2	2.2	.	.	.	.	.	.	.	.	.	.	.	.	3
Crepis leontodontoides All.	.	1.2	.	.	+.2	1.2	.	.	.	.	.	.	.	.	.	.	.	.	3
Silene italica (L.) Pers.	.	1.2	.	.	+	1.2	.	.	.	.	.	.	.	.	.	.	.	.	3
Oryzopsis miliacea (L.) Asch. et Schweinf.	.	.	+.2	.	+.2	.	1.2	.	.	.	.	.	.	.	.	.	.	.	3
Stipa bromoides (L.) Dorfl.	.	.	.	.	+	.	2.2	.	.	.	.	.	.	.	.	.	+	.	3
Helichrysum italicum (Roth) Don	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	3
Cephalaria leucantha (L.) Schrader	.	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	.	3
Dianthus ciliatus Guss.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	1	.	.	.	3
Silene otites (L.) Wibel	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	3
Accidental species	1	1	4	1	12	8	11	7	1	3	0	4	4	5	3	2	6	0	

bassociation *daphneetosun sericeae* Pirone & Cutini 2001. The relevés of the subassociation *daphneetosum sericeae* have been compared with those carried out in the Gargano area in order to put in evidence the differential species between the two communities (Tab. 1).

The coenosis represents low-hilly thermophilus formations characterized by a high amount of species of the *Quercetalia ilicis* order as: *Clematis flammula, Quercus ilex, Phillyrea latifolia* and *Rubia peregrina*. Thus, it represents the coenosis of transition between deciduous shrubs and evergreen sclerophyllous shrubs, on calcareous substrates of the low-hilly areas (Pirone & Cutini, 2002). The community has been classified in the Apennine alliance *Cytision sessilifolii* (Biondi *et al*., 1988). The comparison with the new association described for the Gargano shows some evident analogies in the composition, particularly regarding dominant species as: *Juniperus oxycedrus* and *Daphne sericea*. Nevertheless, the floristic differences are abundant as the lack of characteristic and differential species of the Gargano association such as *Phillyrea media, Pyrus amygdaliformis* and *Euphorbia characias* in addition to the significant presence of species typical of the *Cytision sessilifolii* alliance or more in general of the shrub or Apennine mantle conenoses as: *Chamaecytisus spinescens, Lonicera etrusca, Coronilla emerus* subsp. *emeroides, Quercus pubescens, Spartium junceum, Cytisus sessifolius* and *Rosa canina*. Therefore, it is opportune to attribute the Gargano conenosis to a new and original association.

ANEMONO APENNINAE-QUERCETUM ILICIS ass. nova *hoc loco* (*Holotypus*: rel. 2, Tab. 2)

The several communities of holm oak woods that have been nowadays detected in Gargano (Biondi *et al*., 2003 and 2004) are essentially basophilus and, as already mentioned, the most common rock of the massif is limestone. On the contrary, this holm oak forest seems to be acidophilus and linked to lithologic formations of Maiolica, that in the interested area, are rich in lists and flint nodules. In addition, the holm oak wood under study has more mesophilus characteristics (it occurs in the sectors with medium-low TPI values on higher altitudes and at northern sided or anyway with low S values in Fig.3).

The characteristic species of the new association are: *Anemone apennina, Doronicum orientale, Festuca exaltata* and *Quercus virgiliana* that show the mesophilus aspects (Fig. 3) of the association, in addition to *Daphne sericea*, particularly abundant in this area of Eastern Gargano. Plant communities with *Daphne sericea* have been already indicated in the Italian Adriatic side, in the Abruzzo Apennines, in Conca di Capestrano and in Conca Peligna (at heights of 300-700 m) and have been referred to the association *Cytisophyllo sessilifolii-Quercetum ilicis* (Ciaschetti *et al*., 2004). Characteristic and differential species of this association are: *Daphne sericea*, *Osyris alba, Cytisophyllum sessilifolium, Lonicera etrusca* and *Pistacia terebinthus*. These species do not occur in the new association.

Doronicum orientale reaches in Italy the Western limit of its distribution range whereas has its main diffusion in the Southern part of the Iberian Penisula. This species, particularly abundant in some kinds of mesophilus woods of the Gargano (Biondi *et al*., 2008), is an important floristic element to characterize the mesophilus holm oak woods of "Cave Iblee" in South-West Sicily referred to the association *Doronico orientali-Quercetum ilicis* Barbagallo, Brullo & Fagotto 1979.

The Gargano's woods are floristically very different in comparison to the Sicilian ones, which show some endemic elements as *Scutellaria rubicunda* and *Aristolochia clusii* in addition to other species related to the biogeography of the Island (Brullo *et al*., 2008). In Marettimo Island, in the higher zones, at about 400 – 600 m of altitude, on calcareous sides north facing, in foggy areas, the association *Daphno sericae-Quercetum ilicis* Brullo & Marcenò 1985 was described (Brullo *et al*., 2008.) In this wood, a part from the presence of *Daphne sericea*, the presence of mesophilus species has not been recorded while they occur in the Gargano area. Furthermore, for the association *Anemono apenninae-Quercetum ilicis* the new subassociation *quercetosum dalechampii* (*Holotypus*: rel. 4, Tab.2) has been described which is differentiated by *Quercus dalechampii, Q. cerris, Ostrya carpinifolia, Acer campestre, Cytisus villosus, Crepis leontodontoides* and *Silene italica*, that all together indicate the transition to sub-acidophilus mixed woods of deciduous species.

From the syntaxonomic point of view, all the holm oak woods in Puglia and Gargano are referred to the alliance *Fraxino ornii-Quercion ilicis*, of the order *Quercetalia ilicis* and the class *Quercetea ilicis*.

CYCLAMINO HEDERIFOLII-QUERCETUM VIRGILIANAE Biondi, Casavecchia, Guerra, Medagli, Beccarisi & Zuccarello 2013 *daphnetosum sericeae* subass. nova *hoc loco* (*Holotypus*: rel. 1, Tab. 3)

In the study area, a *Quercus virgiliana* wood has been found and it has been referred to the association *Cyclamino hederifolii-Quercetum virgilianae* already described in the Gargano territories, in the invalid form (Biondi *et al*., 2004) and later validated (Biondi *et al*., 2013). This is a themophilus wood, referred to the mesomediterranean bioclimatic belt that can reach the sub-mediterranean one. Infact, both in the dendogram and in the ordering plot this community appear very close to the relevés belonging to the association *Anemono apenninae-Quercetum ilicis*. Their similarities are due to the ecological characteristics and the floristic combination but considering their physiono-

Tab. 2 - Comparison among the phytosociological relevés of the new association *Anemono apenninae-Quercetum ilicis* ass. nova *hoc loco* and those of the association *Cytisophyllo sessilifolii-Quercetum ilicis* Ciaschetti, Di Martino, Frattaroli & Pirone 2004.

Relevé number	1	2*	3	4**	5	6	7	8	9	10	11	12	13	14	15	16	
Rel. n.in fig. 1,2,3	6	8	17	10	13	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	n.r.	
Altitude (m a.s.l.)	541	517	421	379	421	590	550	660	350	340	520	540	500	580	600	620	
Exposure	N-NE	NNE	E	W-SW	NNE	SW	N	NNW	ESE	ENE	E	SE	SE	SW	NW	SW	
Inclination (à)	20	15	25-30	35	25	20	35	30	25	20	15	10	20	10	15	15	
Area (m2)	400	300	300	450	500	200	150	400	50	400	100	150	100	200	200	200	
Coverage (%)	100	100	85	95	25	85	95	100	40	95	90	100	70	100	95	95	
H veg. (M)	12-15	12-15	10	13	18												Presences
Charact. and diff. species of the association																	
Daphne sericea Vahl	2.2	2.2	3.3	3.3	2.3	1	2	1	+	+	1	1	1	+	+	+	16
Carex hallerana Asso	1.2	1.2	3.4	3.4	3.3	1	1	1	.	.	.	.	.	.	.	.	8
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	.	+.2	2.2	+.2	2.2	.	1	+	.	.	.	.	.	.	.	.	6
Doronicum orientale Hoffm.	2.2	1.2	+	+.2	2.2	.	.	.	.	.	.	.	.	.	.	.	5
Anemone apennina L.	1.2	+	.	.	2.3	.	.	.	.	.	.	.	.	.	.	.	3
Diff. species of the subass. *quercetosun dalechampii*																	
Quercus dalechampii Ten.	.	.	3.3	2.3	+	.	.	.	.	.	.	.	.	.	.	.	3
Quercus cerris L.	.	.	2.3	+	1.1	.	.	.	.	.	.	.	.	.	.	.	3
Ostrya carpinifolia Scop.	.	.	+	+	1.2	.	.	.	.	.	.	.	.	.	.	.	3
Acer campestre L.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	3
Crepis leontodontoides All.	.	.	+	1.2	2.2	.	.	.	.	.	.	.	.	.	.	.	3
Silene italica (L.) Pers.	.	.	1.2	1.2	+	.	.	.	+	+	.	.	.	.	.	.	5
Cytisus villosus Pourret	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	2
Sp. caratt. e diff. dell'ass. *Cytisophyllo sessilifolii-Quercetum ilicis*																	
Osyris alba L.	.	.	.	.	.	1	+	.	1	+	.	.	.	.	+	+	6
Cytisus sessilifolius L.	.	.	.	.	.	+	1	.	.	+	.	.	1	.	+	+	6
Lonicera etrusca Santi	.	+	.	.	.	.	.	1	+	1	1	1	.	.	.	.	6
Pistacia terebinthus L.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	3
Other differential species with regards to the new association																	
Quercus pubescens Willd.	.	.	.	.	.	+	1	+	1	+	2	1	1	+	+	1	11
Coronilla emerus L. ssp. emeroides	.	.	.	.	.	1	1	+	1	2	1	+	.	+	+	+	10
Carpinus orientalis Miller	.	.	.	.	.	1	3	2	.	+	.	1	.	2	1	2	8
Arbutus unedo L.	.	.	.	.	.	1	.	.	.	.	1	.	.	1	+	1	5
Acer monspessulanum L.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	+	1	5
Brachypodium sylvaticum (Hudson) Beauv.	.	.	1.2	.	.	.	1	+	.	+	.	.	.	.	.	.	4
Cyclamen repandum S. et S.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	1	4
Asplenium adiantum-nigrum L.	.	.	.	.	.	.	1	.	.	.	.	.	.	+	+	1	4
Charact. and diff. species of the all. *Fraxino orni-Quercion ilicis*																	
Quercus ilex L.	5.5	5.5	5.5	5.5	5.5	4	2	3	3	5	3	4	3	4	4	2	16
Fraxinus ornus L.	+.2	2.2	1.2	1.2	1.2	+	1	2	.	1	1	+	1	+	+	1	15
Cyclamen hederifolium Aiton	2.3	2.2	.	2.3	3.3	+	1	+	.	+	1	1	+	1	1	+	14
Tamus communis L.	1.2	1.2	.	1.2	1.1	.	.	.	.	.	.	.	.	.	+	.	5
Festuca exaltata C. Presl	.	1.2	.	2.2	2.2	.	.	.	.	.	.	.	.	.	.	.	3
Quercus virgiliana (Ten.) Ten.	.	+	.	1.1	1.1	.	.	.	.	.	.	.	.	.	.	.	3
Charact. and diff. species of the order *Quercetalia ilicis* and the class *Quercetea ilicis*																	
Juniperus oxycedrus L.	+	1.2	.	2.3	+	1	+	+	2	+	1	1	1	+	.	+	14
Asparagus acutifolius L.	.	+	1.2	1.2	.	+	1	+	.	1	.	1	+	+	+	+	12
Phillyrea media	+.2	1.2	1.2	3.3	2.2	1	.	+	1	.	.	.	.	1	+	1	11
Rubia peregrina L.	.	.	.	+.2	1.2	+	.	+	.	.	+	+	+	+	+	.	9
Ruscus aculeatus L.	.	.	+	.	+	+	.	1	.	1	.	.	.	+	+	+	8
Clematis flammula L.	.	.	.	+.2	.	.	.	.	.	1	+	.	1	+	+	.	6
Allium subhirsutum L.	1.2	.	+	1.1	1.1	.	.	.	.	.	.	.	.	.	.	.	4
Rosa sempervirens L.	.	.	.	1.2	.	.	+	.	.	.	.	.	+	.	.	.	3
Pinus halepensis Miller	.	.	.	.	.	.	.	.	.	.	1	2	1	.	.	.	3
Asplenium onopteris L.	.	.	+	1.1	.	.	.	.	.	.	.	.	.	.	.	.	2
Erica arborea L.	2.2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Viburnum tinus L.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1
Other species																	
Bellis sylvestris Cyr.	1.2	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	4
Geranium purpureum Vill.	+.2	.	.	+	1.1	.	.	.	.	.	.	.	.	.	.	.	3
Ranunculus lanuginosus L.	.	1.2	.	1.2	2.2	.	.	.	.	.	.	.	.	.	.	.	3
Clinopodium vulgare L.	.	.	+	1.1	.	+	.	.	.	.	.	.	.	.	.	.	3
Dactylis glomerata L.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	3
Sorbus domestica L.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	3
Teucrium flavum L.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	3
Dorycnium hirsutum (L.) Ser.	.	.	.	.	.	.	.	.	1	+	.	.	+	.	.	.	3
Brachypodium distachyum (L.) Beauv.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	3
Euonymus europaeus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	3
Accidental species	0	7	6	10	9	3	6	7	8	4	3	3	3	2	2	0	

mic structure, we think that the separation into two different association is more appropriate. In the studied vegetation, in addition to the characteristic species of the association, several mesophilus species have been detected such as: *Daphne sericea*, *Doronicum orientale*, *Anemone apennina* and *Klasea flavescens* subsp. *cichoracea* that allow us to differentiate the new subass. *daphnetosum sericeae*.

PHYSOSPERMO VERTICILLATI-QUERCETUM CERRIS Aita *et al*. 1997 em Ubaldi *et al*. 1987 *daphnetosum sericeae* subass. nova *hoc loco* (*Holotypus*:

Tab. 3 - *Cyclamino hederifolii-Quercetum virgilianae* Biondi *et al.* ex Biondi, Casavecchia, Guerra, Medagli, Beccarisi & Zuccarello in Biondi, Allegrezza, Casavecchia, Galdenzi, Gigante & Pesaresi 2013 subass. *daphnetosum sericeae* subass. nova *hoc loco*.

Relevé number	1
Rel. n. in fig. 1,2,3	14
Altitude (m a.s.l.)	426
Exposure	WSW
Inclination (°)	35
Area (m2)	350
Coverage (%)	100
H veg. (m)	22
Charact. and diff. species of the ass.	
Quercus virgiliana (Ten.) Ten.	5.5
Cyclamen hederifolium Aiton	3.4
Festuca exaltata C. Presl	2.3
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	1.2
Diff. species of the subass. *daphnetosum sericeae*	
Daphne sericea Vahl	3.4
Anemone apennina L.	2.2
Klasea flavescens subsp. cichoracea (L.) Greuter & Wagenitz	2.2
Doronicum orientale Hoffm.	1.2
Charact. and diff. species of the all. *Carpinion*	
Luzula forsteri (Sm.) DC.	2.3
Phillyrea media L.	2.3
Ranunculus lanuginosus L.	2.2
Quercus cerris L. pl.	1.2
Inula conyza DC.	1.2
Asparagus acutifolius L.	1.2
Sorbus torminalis (L.) Crantz	1.1
Rosa sempervirens L.	+.2
Teucrium siculum Rafin.	+.2
Hedera helix L.	+.2
Buglossoides purpurocaerulea (L.) Johnston	+
Charact. species of the class *Trifolio-Geranietea sanguinei*	
Oenanthe pimpinelloides L.	2.3
Silene italica (L.) Pers.	1.2
Clinopodium vulgare L.	+.2
Acinos alpinus (L.) Moench	+
Silene alba (Miller) Krause	+
Charact. species of the class *Quercetea ilicis*	
Juniperus oxycedrus L.	2.3
Carex hallerana Asso	2.3
Allium subhirsutum L.	2.2
Quercus ilex L.	1.2
Other species	
Crepis leontodontoides All.	1.2
Trifolium angustifolium L.	1.2
Bellis sylvestris Cyr.	1.1
Carex flacca Schreber ssp. serrulata (Biv.) Greuter	+.2
Poa trivialis L.	+
Geranium purpureum Vill.	+

rel. 1, Tab. 4)

This plant community is more mesophilus and develops in the narrowest part of the valley where the daylight is minimum (low TPI60, SLO and S, Fig. 3) and the humidity is maximum. Thus, this is a mesophilus community that, as the ones already described, is slightly distributed in the study area and therefore it has a high ecologic interest. In the Gargano peninsula, mesophilus Turkey oak woods have been previously attributed to the association *Physospermo verticillati-Quercetum cerris* Aita *et al.*, 1977 em. Ubaldi *et al.*, 1987 (Biondi *et al.*, 2008) of which three subassociations have been already described: *pulmonarietosum apenninae*, *ericetosum arboreae* and *phillyretosum mediae* (Biondi *et al.*, 2004 and 2013). The new proposed subassociation has some similarities with the subassociation *phillyretosum mediae* because both are thermophilus. Nevertheless, the new subassociation is clearly acidophilus as indicated by the presence of the differential species *Daphne sericea*, *Asphodeline liburnica*, *Oenanthe pimpinelloides*, *Klasea flavescens* subsp. *cichoracea*, *Astragalus glycyphyllos*, *Cruciata glabra*, *Orchis maculata* subsp. *fuchsii*.

Moreover, several characteristic species of the allian-

Tab. 4 - *Physospermo verticillati-Quercetum cerris* (Aita, Corbetta & Orsino 1977) em. Ubaldi *et al.* 1987 *daphnetosum sericeae* subass. nova *hoc loco*.

	GAR97
Relevé number	1
Rel. n. in fig. 1,2,3	15
Altitude (m a.s.l.)	490
Exposure	SE
Inclination (°)	35
Area (m2)	600
Coverage (%)	100
H veg. (M)	25
Charact. species of the ass. *Physospermo verticillati-Quercetum cerris*	
Quercus cerris L.	5.5
Aremonia agrimonoides (L.) DC.	2.2
Diff. species of the subass. *daphnetosum sericeae*	
Daphne sericea Vahl	4.5
Juniperus oxycedrus L.	3.3
Oenanthe pimpinelloides L.	2.2
Klasea flavescens subsp. cichoracea (L.) Greuter & Wagenitz	1.2
Asphodeline liburnica (Scop.) Rchb.	+.2
Cruciata glabra (L.) Ehrend.	+.2
Orchis maculata L. ssp. fuchsii (Druce)	+
Astragalus glycyphyllos L.	+
Charact. and diff. species of the all. *Physospermo verticillati-Quercion cerris*	
Acer obtusatum W. et K. ssp. neapolitanum Ten.	3.4
Anemone apennina L.	2.2
Doronicum orientale Hoffm.	1.2
Arum lucanum Cavara et Grande	1.1
Charact. species of the ord. *Fagetalia sylvaticae*	
Festuca heterophylla Lam.	2.2
Brachypodium sylvaticum (Hudson) Beauv.	1.2
Melica uniflora Retz.	1.2
Rosa arvensis Hudson	+
Galium rotundifolium L.	+
Charact. species of the class *Querco-Fagetea*	
Viola alba Besser ssp. dehnhardtii (Ten.) W.	2.3
Cyclamen hederifolium Aiton	2.3
Luzula forsteri (Sm.) DC.	2.2
Potentilla micrantha Ramond	2.2
Buglossoides purpurocaerulea (L.) Johnston	1.2
Lathyrus venetus (Miller) Wohlf.	1.2
Hedera helix L.	+.2
Tamus communis L.	+.2
Inula conyza DC.	+.2
Hieracium racemosum W. et K.	+.2
Acer campestre L.	+
Clematis vitalba L.	+
Other species	
Quercus ilex L.	3.4
Carex hallerana Asso	2.3
Phillyrea media L.	2.2
Silene italica (L.) Pers.	1.2
Bellis sylvestris Cyr.	1.2
Geranium sanguineum L.	1.2
Festuca exaltata C. Presl.	1.2
Asphodelus microcarpus Salzm. et Viv.	1.2
Crepis leontodontoides All.	1.2
Carex flacca Schreber	1.2
Clinopodium vulgare L.	1.2
Rubus ulmifolius Schott	1.1
Prunus spinosa L.	+
Allium subhirsutum L.	+
Fragaria vesca L.	+
Geum urbanum L.	+

ce *Physospermo verticillati-Quercion cerris* occur in this community, to which the new subassociation is referred (Košir *et al*., 2013).

DAPHNO SERICEAE-CISTETUM MONSPELIENSIS ass. nova *hoc loco* (*Holotypus*: rel. 2, Tab. 5)

At the edges of woods of the study area, discontinuous and rare shrubs have been detected, which represent the recovery vegetation after fire. This community shows higher TPI and it does not occur on warm expositions. Because of the acidity of the substratum, the vegetation is dominated by *Cistus monspeliensis* with *Daphne sericea* and *Erica arborea* (characteristic species). Moreover, there are species of higher hierarchical level such as *Cistus creticus* subsp. *creticus, C. salvifolius* and *Calicotome villosa*. Some characteristic species of the order *Pistacio-Rhamnetalia alaterni* and in general *Quercetea ilicis* are considered linked species.

Conclusions

The study of the vegetation in which *Daphne sericea* takes part in the Gargano Promontory has shown that this plant is able to colonize forest ecosystems, micro woods and shrublands being very different in ecological terms. Figure 3 clearly shows that, even if *Daphne sericea* occurs in all the ecological conditions of the study area, it has the highest covariance with *Erica arborea* and *Cistus monspeliensis*. Its behaviour appears to be linked to the particular characteristics of the calcareous substrate of the study area on which the vegetation settles and where the presence of chert nodules and layers often causes some characteristics of acidity of the soil.

The variability of the conditions of micro woods and forests related to very different ecological conditions allows to indirectly assessing the ability of colonization (ecological amplitude) of *Daphne sericea*. Indeed, this species can grow on xerophytic formations, as evidenced by the subassociation *oleetosum sylvestris* of the association *Daphno sericeae-Juniperetum oxycedri* in which the species belonging to the order *Pistacio-Rhamnetalia alaterni* are abundant.

The gradient of mesophily is growing, starting from this cenosis towards the other communities described, among which the subassociation *quercetosun dalechampii* of the evergreen wood of the association *Anemono apenninae-Quercetum ilicis* represents the transition to deciduous formations that are more mesophilus such as the subassociation *daphnetosum sericeae* of the association *Cyclamino hederifolii-Quercetum virgilianae*. In the narrowest and more humid part of the valley, *Daphne sericea* still occurs and gives rise to the new subassociation *daphnetosum sericeae* of the association *Physospermo verticillati-Quercetum cerris*

Tab. 5 - *Daphno sericeae-Cistetum monspeliensis* ass. nova *hoc loco*

Relevé number	1	2*	
Rel. n. in fig. 1,2,3	4	5	
Altitude (m a.s.l.)	398	540	
Exposure	NNE	W-NW	
Inclination (°)	35	20	
Area (m2)	350	500	
Coverage (%)	95	100	
H veg. (m)	1,5	1.3	Presences
Charact. and diff. species of the ass. and of the class *Cisto cretici-Micromerietea julianae*			
Cistus monspeliensis L.	5.5	4.5	2
Daphne sericea Vahl	3.3	3.4	2
Phillyrea media	2.2	2.2	2
Erica arborea L.	1.2	2.2	2
Cistus creticus L. ssp. creticus	1.2	1.2	2
Cistus salvifolius L.	.	2.3	1
Calicotome villosa (Poiret) Link	.	1.2	1
Charact. species of the order *Pistacio-Rhamnetalia alaterni* and of the class *Quercetea ilicis*			
Cyclamen hederifolium Aiton	2.3	2.2	2
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	2.3	1.2	2
Pistacia lentiscus L.	1.2	2.2	2
Allium subhirsutum L.	1.2	1.2	2
Asparagus acutifolius L.	1.2	2.2	2
Quercus ilex L.	1.1	2.2	2
Rubia peregrina L.	1.2	+	2
Fraxinus ornus L.	+	+	2
Clematis flammula L.	1.2	.	1
Rosa sempervirens L.	1.2	.	1
Juniperus oxycedrus L.	1.1	.	1
Carex hallerana Asso	.	1.2	1
Tamus communis L.	.	+.2	1
Other species			
Geranium sanguineum L.	2.3	1.2	2
Crepis leontodontoides All.	2.2	1.2	2
Asphodeline liburnica (Scop.) Rchb.	2.2	+.2	2
Euphorbia characias L.	1.2	1.2	2
Teucrium chamaedrys L.	+.2	+.2	2
Sanguisorba minor Scop.	+.2	+	2
Doronicum orientale Hoffm.	+	+.2	2
Carex digitata L.	+.2	+.2	2
Dorycnium hirsutum (L.) Ser.	+	+	2
Ranunculus lanuginosus L.	2.3	2.2	2
Silene italica (L.) Pers.	1.2	.	1
Oenanthe pimpinelloides L.	1.1	.	1
Asphodelus microcarpus Salzm. et Viv.	.	1.1	1
Oryzopsis miliacea (L.) Asch. et Schweinf.	.	+.2	1
Acinos alpinus (L.) Moench	.	+	1
Anemone apennina L.	2.2	.	1
Anthoxanthum odoratum L.	.	+.2	1
Anthyllis vulneraria L.	.	+	1
Carex flacca Schreber ssp. serrulata (Biv.) Greuter	1.2	.	1
Cistus creticus L. ssp. eriocephalus Greuter & Burdet	.	1.2	1
Galium laevigatum L.	1.1	.	1
Hieracium sp.	+	.	1
Lamium bifidum Cyr.	+	.	1
Lathyrus sp.	+	.	1
Lilium bulbiferum L. ssp. croceum (Chaix) Baker	+	.	1
Luzula forsteri (Sm.) DC.	+.2		1
Myosotis sp.	+	.	1
Prunus spinosa L.	.	+	1
Pulicaria odora (L.) Rchb.	.	+.2	1
Quercus cerris L. (pl)	.	+	1
Quercus pubescens Willd.	.	1.1	1
Rubus ulmifolius Schott	.	+.2	1
Sorbus torminalis (L.) Crantz	+	.	1

which shows that the increasing of the acidity of the substrate is linked to the gradient of increasing mesophily. To conclude we want to underline the amazing degree of complexity that Gargano promontory holds in such a limited area of its territory.

Concerning the conservation meaning of the communities identified on the basis of Directive 92/43/CEE, the communities of the association *Daphno-Juniperetum oxycedri* are part of the Habitat 5210: "Arborescent matorral with *Juniperus* spp." and more precisely, it corresponds to the CORINE Biotopes' code 32.131 - *Juniperus oxycedrus* arborescent matorral (= EUNIS F5.131). The holm oak woods of the association *Anemono Apenninae-Quercetum ilicis* are part of the Habitat 9340 which groups together all *Quercus ilex* formations, whereas oaks woods of *Quercus virgiliana*, belonging to the association *Cyclamino hederifolii-Quercetum virgilianae* in the subassociation *daphnetosum sericeae* are part of the priority habitat 91AA*:"Eastern white oak woods", Corine's code 41.732 "Southern Italian and Sicilian *Quercus pubescens* woods" (=EUNIS G1.73). The mesophilus Turkey oak woods belonging to the subassociation *daphnetosum sericeae* of the association *Physospermo verticillati-Quercetum cerris* are part of the Habitat 91L0 "Illyrian oak-hornbeam forests (*Erythronio-Carpinion*)". All these coenoses are very significant and taking in consideration the particular distribution of *Daphne sericea*, they deserve to be managed in a very careful way.

Syntaxonomic scheme

QUERCETEA ILICIS Br.-Bl. ex A. & O. Bòlos 1950
Quercetalia ilicis Br.-Bl. ex Molinier 1934
Fraxino orni-Quercion ilicis Biondi, Casavecchia & Gigante 2003
Anemono apenninae-Quercetum ilicis ass. nova *hoc loco*
Pistacio lentisci-Rhamnetalia alaterni Rivas-Martínez 1975
Oleo sylvestris-Ceratonion siliquae Br.-Bl. ex Guinochet & Drouineau 1944
Daphno sericeae-Juniperetum oxycedris ass. nova *hoc loco*

QUERCO ROBORIS-FAGETEA SYLVATICAE Br.-Bl. & Vlieger in Vlieger 1937
Quercetalia pubescenti-petraeae Klika 1933
Carpinion orientalis Horvat 1958
Lauro nobilis-Quercenion virgilianae Ubaldi (1988) 1995 corr. Biondi, Casavecchia & Pesaresi 2010
Cyclamino hederifolii-Quercetum virgilianae Biondi *et al.* ex Biondi, Casavecchia, Guerra, Medagli, Beccarisi & Zuccarello in Biondi Allegrezza, Casavecchia, Galdenzi, Gigante & Pesaresi 2013
daphnetosum sericeae subass. nova *hoc loco*
Fagetalia sylvaticae Pawlowski in Pawlowski, Sokolowski & Wallisch 1928
Physospermo verticillati-Quercion cerridis Biondi *et al.* ex Biondi, Casavecchia & Biscotti in Biondi, Allegrezza, Casavecchia, Galdenzi , Gigante & Pesaresi 2013
Physospermo verticillati-Quercenion cerridis Biondi *et al.* ex Biondi, Casavecchia & Biscotti in Biondi, Allegrezza, Casavecchia, Galdenzi, Gigante & Pesaresi 2013
Physospermo verticillati-Quercetum cerris Aita *et al.* 1977 em. Ubaldi *et al.* 1987
daphnetosum sericeae subass. nova *hoc loco*

CISTO CRETICI-MICROMERIETEA JULIANAE Oberdorfer ex Horvatić 1958
Cisto cretici-Ericetalia manipuliflorae Horvatić 1958
Cisto cretici-Ericion manipuliflorae Horvatić 1958
Daphno sericeae-Cistetum monspeliensis ass. nova *hoc loco*

List of the syntaxa not quoted in the syntaxonomic scheme

Chamaecytiso spinescentis-Juniperetum oxycedri Pirone & Cutini 2001
daphneetosum sericeae Pirone & Cutini 2001
Cytision sessilifolii Biondi in Biondi, Allegrezza & Guitian 1988
Cytisophyllo sessilifolii-Quercetum ilicis Ciaschetti, Di Martino, Frattaroli & Pirone 2004
Doronico orientali-Quercetum ilicis Barbagallo, Brullo & Fagotto 1979
Daphno sericae-Quercetum ilicis Brullo & Marcenò 1985

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Appendix I: dates and localities of relevés

Coordinate system: UTM (WGS84) Zone 33N (unit = meters).
Tab. 1: Rel. 1-2: (x = 591992, y = 4629940) along the road to Valle Baracca (04.05.2010); rel. 3: (x = 594776, y = 4628094) Sagro, near Masseria Sgarrazzo (03.05.2010); rel. 4: (x = 594648, y = 4628964) Sagro, near Masseria Sgarrazzo (03.05.2010); rel. 5: (x = 594925, y = 4628030) Sagro, near Masseria Sgarrazzo (03.05.2010); rel. 6: (x = 593297, y = 4626844,) Sagro, near Masseria Sgarrazzo (03.05.2010); rel. 7: (x = 592342, y = 4628858) along the Road Vieste-Mattinata (06/08/2010). Rel. 8-18: from Pirone & Cutini 2002, tab. 1 rel. 29-39.
Tab. 2: Rel. 1: (x = 593484, y = 4627209) between Masseria Sgarrazza and Masseria Madiola (03.05.2010); Rel. 2: (x = 593297, y = 4626844) between Masseria Sgarrazza and Masseria Madiola (03.05.2010); rel. 3: (x = 592425, y = 4628863) along the road Vieste-Mattinata (06.08.2010); rel. 4: (x = 591966, y = 4629937) along the road to Valle Baracca (04.05.2010); rel. 5: (x = 592360, y = 4629082) along the road to Valle Baracca (04.05.2010); rel. 6-16: from Ciaschetti et al. 2004, tab. 3 rel. 1-11.
Tab. 3: Rel. 1: (x = 592564, y = 4628971) along the road to Valle Baracca (04.05.2010).
Tab.4: Rel.1: (x = 592312, y = 4627021) along the road to Valle Baracca (04.05.2010).
Tab. 5: Rel. 1: (x = 594239, y = 4627908) along the road Vieste-Mattinata (03.05.2010); rel. 2: (x = 593572, y = 4627464) along the road Vieste-Mattinata (03.05.2010).

Appendix II: Sporadic species

Tab. 1: Rel. 1: Serratula cichoracea 1.2; rel. 2: Serratula cichoracea +; rel. 3: Arum italicum 1.2, Clinopodium vulgare +, Paliurus spina-christi +.2, Barlia robertiana +; rel. 4: Arum italicum +.2; rel. 5: Asphodeline liburnica +.2, Arum lucanum 1.2, Rosa sp. +.2, Selaginella denticulata +.2, Buglossoides purpurocaerulea +, Inula conyza +, Theligonum cynocrambe +, Umbilicus rupestris +, Urginea maritima +, Ajuga reptans +, Teucrium siculum +, Galium aparine +; rel. 6: Asphodeline liburnica 1.2, Anthoxanthum odoratum 1.2, Doronicum orientale 2.3, Bellis sylvestris 1.1, Geranium sanguineum 1.2, Asphodelus microcarpus +.2, Rubus ulmifolius +, Thapsia garganica +; rel. 7: Clinopodium vulgare +, Petrorhagia saxifraga +.2, Teucrium polium +, Acinos alpinus 1.2, Briza maxima +, Bromus hordeaceus +, Calamintha nepeta +, Catapodium balearicum +, Cynosurus echinatus +, Gastridium ventricosum +, Lagurus ovatus +; rel. 8: Teucrium polium +, Fumana procumbens +, Euphorbia spinosa 1, Festuca gr.inops +, Sideritis syriaca +, Thymus gr. serpyllum +, Teucrium polium subsp. capitatum +; rel. 9: Ophrys sphecodes +; rel. 10: Silene vulgaris +, Galium parisiense 1, Hieracium pilosella +; rel. 12: Petrorhagia saxifraga +, Silene vulgaris +, Eryngium campestre +, Dactylis glomerata +; rel. 13: Fumana procumbens 1, Satureja montana subsp. montana 1, Aethionema saxatile 1, Fumana thymifolia 2; rel. 14: Ophrys sphecodes +, Satureja montana subsp. montana 1, Aethionema saxatile 1, Lotus corniculatus +, Urospermum dalechampii +; rel. 15: Lotus corniculatus +, Galium corrudifolium +, Stachys recta +,; rel. 16: Galium corrudifolium +, Coronilla minima +; rel. 17: Euphorbia spinosa 1, Coronilla minima 1, Dianthus sylvestris +, Elaeoselinum asclepium +, Hyssopus officinalis +, Teucrium flavum.

Tab. 2: Rel. 2: Asphodeline liburnica +.2, Sorbus torminalis 1.1, Carex flacca subsp. serrulata 1.2, Arabis collina +, Geranium sanguineum 1.1, Rubus ulmifolius +, Rosa arvensis +; ril. 3: Asphodeline liburnica +, Hedera helix 2.3, Asplenium trichomanes +, Buglossoides purpurocaerulea 1.1, Clematis vitalba +, Ceterach officinarum +; rel. 4: Sorbus torminalis 1.1, Carex flacca subsp. serrulata +, Serratula sp., 2.2, Inula conyza 1.2, Luzula forsteri 1.2, Ajuga reptans +, Stipa bromoides +, Hypericum montanum +, Umbilicus rupestris +, Vicia sepium +; rel. 5: Hedera helix +.2, Oenanthe pimpinelloides 1.2, Lathyrus venetus 1.2, Lilium bulbiferum subsp. croceum 1.2, Arum lucanum 1.1, Stellaria media +.2, Melica uniflora +.2, Potentilla micrantha +, Galium laevigatum +; rel. 6: Cistus creticus subsp. creticus +, Chamaecytisus spinescens +, Helianthemum oelandicum subsp. incanum +; rel. 7: Arabis collina 1, Sorbus aria +, Cephalanthera longifolia 1, Hieracium murorum 1, Euonymus verrucosus 1, Helleborus foetidus +; rel. 8; Sorbus aria +, Cephalanthera damasonium +, Laburnum anagyroides 1, Luzula sylvatica 1, Cornus mas 1, Stachys officinalis subsp. officinalis +, Lonicera caprifolium +; rel. 9: Linum tommasinii +, Micromeria graeca subsp. graeca+, Argyrolobium zanonii +, Cistus salvifolius +, Spartium junceum +, Hieracium pilosella +, Anthyllis vulneraria +, Arabis hirsuta 1; rel. 10: Cephalanthera damasonium +, Geranium robertianum 1, Stachys recta +, Anemone hortensis +; rel. 11: Epipactis helleborine +, Leontodon crispus subsp.asper +, Daphne laureola +; rel. 12: Cistus creticus subsp. creticus +, Epipactis helleborine +, Orchis purpurea +; rel. 13: Orchis purpurea +, Scabiosa columbaria 1, Prunus spinosa 1; rel. 14: Asplenium trichomanes +, Ligustrum vulgare +; rel. 15: Ligustrum vulgare +, Asplenium ruta-muraria +.