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Analysis of forest diversity in an area of high presence of *Taxus baccata* L. and *Ilex aquifolium* L..The study case in the central Apennines (Italy)

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Abstract
This is a detailed study of the *Taxus baccata* coenosis and other related woods of the calcareous ridge of Cingoli, as part of the lower peaks of the Umbria-Marche Apennines. This entire calcareous ridge has already undergone phytosociological studies. The aim of this study is to highlight the vegetation diversity of the biotope, as correlated with the complex morphology of the valley, its different ecological conditions, and the human activity of coppicing. The study area is the 'Macchia delle Tassinete' Site of Community Importance, and it is the third lowest peak positioned between the Marche Apennines and the Adriatic Sea, with a NE-SW orientation. It is also characterised by the presence of populations of yew (*T. baccata*) and holly (*Ilex aquifolium*). The yew is found throughout the Italian regions, although in isolated and extremely limited areas, as relict forms of the Tertiary that have been preserved to date. These enclaves are present throughout the central-southern Apennines, but the object of the present study is certainly one of the largest and easternmost remaining areas for *T. baccata* in central Italy.
The plant communities dominated by yew are in the first part of the valley of the river Fosso delle Scalette. Here, the exposure to humid winds coming from the sea and the northern quadrants creates microclimatic conditions that are suitable for the development of *T. baccata*, which grows best on calcareous substrates and in an oceanic climate. This coenosis is attributed to the new association *Staphyleo pinnatae-Taxetum baccatae*.
Despite the low altitude, in the more shady and humid areas, there is a beech forest suited to low altitudes that includes yew, which has allowed the description of the new association *Asparago acutifolii-Fagetum sylvaticae*. This new association has been attributed to the new suballiance described here for the first time, named *Lathyro veneti-Fagenion*, included in the alliance *Aremonio-Fagion*. This new suballiance groups together the thermophilus beech forests of the mesotemperate bioclimatic belt of the central Apennines.
Along the slopes, on a narrow but flat terrace where the soil is deep and fresh, there is an original wood dominated by *Quercus cerris* with abundant *Ilex aquifolium* and other mesophilus trees. This has been attributed to the new association *Taxo baccatae-Quercetum cerris*, which also occurs with the subassociation *fagetosum sylvaticae*, and is included in the endemic Italian alliance *Physospermo-Quercion cerris*.
In the sunny and dry areas, species of the order *Fagetalia* decrease, and the beech forest gives way to forest dominated by *Ostrya carpinifolia* that has been attributed to the association *Scutellario columnae-Ostryetum carpinifoliae*. There are also more thermophilus woods that are dominated by white oak and are rich in Mediterranean species, and have thus been attributed to the association *Roso sempervirentis-Quercetum virgilianae*.
In conclusion, the importance of the conservation of this rich diversity in forest typologies is highlighted by their inclusion in the different European Union Habitats, *sensu* Habitats Directive.

Key words: 92/43/EEC Directive, forest biodiversity, *Ilex aquifolium*, *Lathyro veneti-Fagenion sylvatica*e, phytosociology, *Taxus baccata*.

Introduction

This research deals with the knowledge about the ecology of mesophilus woods with high presence of *Taxus baccata* in the tree layer and *Ilex aquifolium* in the shrub one.

The yew is a Paleotemperate element with an oceanic nature that can be found throughout Europe. Its northern limits extend from the British Isles to Norway, Sweden and Finland, its eastern border runs from Riga Bay (Latvia) through Bialowiecza (on the Belarus–Poland border), along the 23rd meridian, to the eastern Carpathians and the Black Sea, where *Taxus* occurs on the Crimean peninsula and across northern Turkey. The southern limit includes Portugal and the Mediterranean countries of Europe, and also Madeira, the Atlas Mountains (Algeria), the northern Pontus, the Taurus and Amanus Mountains (southern Turkey, northern Syria), the entire Caucasus, and the Elburs Mountains in northern Iran. Within this wide range, *Taxus* is not found in the regions influenced by the continental climate (e.g., eastern Europe, the Anatolian highlands, the Hungarian lowlands), nor in the higher mountains (e.g., central Alps, central Carpathians) (Hageneder, 2007). In areas with an oceanic climate, such as the Atlantic coasts of Normandy and Brittany, *Taxus* is commonly found in beech forests also below 300 m a.s.l., where it can form dense populations (Abbate *et al*., 2003). In the more continental areas of central Europe, the European yew is relegated to submontane beech woods and to shady slope environments where there is higher humidity and little temperature variation. The ecological needs of the species and human activities have resulted in a discontinuous distribution of *T. baccata* in Temperate Europe (Durin *et al*.,1967).

T. baccata, mainly associated to *I. aquifolium*, having both the same ecological needs, develops best on limestone substrate, as seen for the associations dominated by *Taxus* described in the literature: *Taxo-Fagetum* of the Swiss Pre-Alps and central-southern Germany; *Carici-Fagetum* of the sub-Atlantic countries; the Atlantic calcareous *Taxus* woods of England;

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and *Daphno-Fagetum* of Normandy, France. In some cases, however, the European yew is also found on acidophilus substrates, such as for the association *Rusco aculeati-Fagetum sylvaticae*, which was described for the Armorican beech woods of Brittany, France (Durin *et al*., 1967).

T. baccata can be found in all of the Italian regions, although this occurs in isolated and extremely limited locations, essentially as relict forms of the Tertiary that have been preserved to date. *Taxus* is present in montane microthermal beech woods of the alliance *Aremonio-Fagion*, in the thermophilus beech woods of the alliance *Geranio versicoloris-Fagion*, in the deciduous mixed woods with beech of the suballiance *Laburno-Ostryenion*, and as azonal mixed woods of the alliance *Tilio-Acerion*, in ravines and narrow valleys. It also occurs in areas characterised by Mediterranean zonal vegetation, such as in Tuscany, Sardinia and Sicily (Abbate *et al*., 2003). Even in Italy, *T. baccata* develops best on limestone substrates, even if acidophilus aspects occur in Abruzzo and northern Marche.

The aim of the present study was to improve the knowledge of the forest ecosystems of the 'Macchia delle Tassinete' Site of Community Importance (SCI; IT 53330013), and to update the relevant maps. The study area is part of the calcareous ridge of Cingoli, which is the third lowest peak of the Umbria-Marche Apennines, and which is positioned between the Marche Apennines and the Adriatic Sea, at a NE-SW orientation.

The vegetation of the study area has been the subject of previous phytosociological studies that encompassed the entire calcareous ridge (Abbate *et al*., 2003; Biondi, 1982; Taffetani *et al*., 2004). The present study highlights the greater vegetation variety of the biotope that is correlated with the complex morphology of the valley, and the different ecological conditions that prevail, which allows the identification of the European Union habitat, sensu Habitats Directive (92/43/CEE) (Biondi, 2013; Biondi *et al*., 2012).

The floristic and vegetation interest in the area is linked to the beech forest and the large community of European yew (*Taxus baccata* L.), which despite the low altitude, is located in the more shady and humid areas of this SCI.

Enviromental characteristics of the study area

The Macchia delle Tassinette SCI is one of the three sites of community interest of the ridge of the Cingoli Mountains (Monti di Cingoli; Fig.1). This ridge is an outcrop of carbonate rock of limited extension that is oriented NW-SE in the hills of the Marche region (central Italy). These calcareous hills in the Cingoli ridge are characterised by flat tops, steep slopes, and deep valleys. The whole area is included in the high hilly belt, with altitudes between 450 m and 760 m a.s.l.. In this area, the most important river is Fosso delle Scalette, which rises in the Tassinete area, and flows down to the village of Capo di Rio, becoming enriched by small springs along its path. From a lithological point of view, the Cingoli ridge is characterised by peaks of calcareous origin from the Jurassic-Oligocene period. The most frequent rocky outcrops are white limestone of the Triassic, compact limestone of the Jurassic, and white limestone of the Cretaceous.

The bioclimatic analysis was made using the bioclimatic map of Italy (Pesaresi *et al*., 2014), and according to the latest bioclimatic classification (Rivas-Martínez *et al*., 2011). In the study area, there are two distinct isobiocimates: (i) a Temperate oceanic (submediterranean variant) macrobioclimate, of the Lower Supratemperate thermotype, with a Lower Humid ombric horizon; and (ii) a Temperate oceanic (submediterranean variant) macrobioclimate, of the Upper Mesotemperate thermotype, with a Lower Humid ombric horizon. This latter is according to the nearest thermopluviometrical station (Cingoli).

Materials and methods

The woodland vegetation of the study area was sampled through 35 phytosociological relevés. For the plant classification, the following publications were used: Flora Europaea (Tutin *et al*., n.d., 1993), Flora d'Italia (Pignatti, 1982) and the checklist of Flora d'Italia (Conti *et al*., 2005; Conti *et al*., 2007). For the analysis of the plant communities, the phytoso-

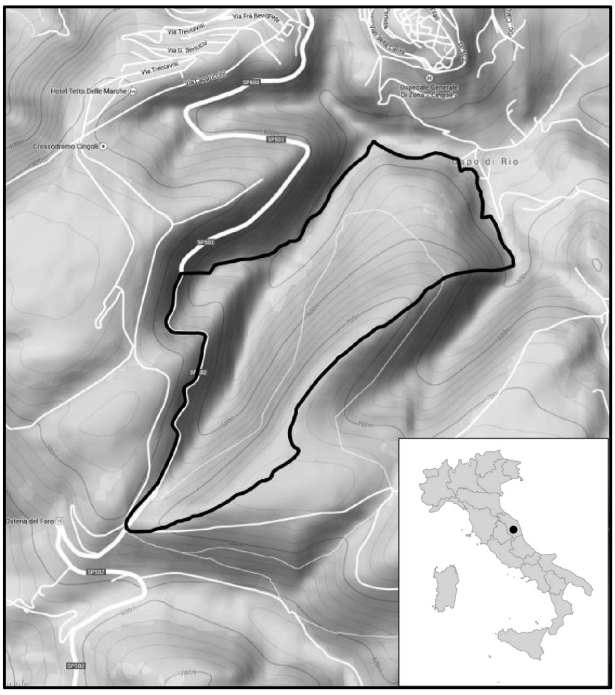

Fig. 1 - Map showing the location of the study area.

ciological method of the Sigmatist School of Zurigo-Montpellier was used, as proposed by Braun-Blanquet (Braun-Blanquet, 1964), and later developed and integrated through various studies (Biondi, 1994, 2011; Biondi *et al*., 2004; Géhu *et al*., 1991; Rivas-Martínez, 2005; Theurillat, 1992a,b; Tüxen, 1956, 1977, 1979). The syntaxonomic classification follows the Prodrome of Vegetation of Italy, up to the level of the alliance (Biondi *et al*., 2014).

Vegetation analysis

The statistical analysis has been carried out on the relevés concerning mesophilus woods; in the section about the description of the different association found in the study area we, also, reported the description of white oak termophilus woods.

With the cover abundance values converted to the Van der Mareel scale (Maarel van der, 1979), the vegetation data matrix (34 phytosociological relevés × 117 species) was classified by cluster analysis. In particular, the Fuzzy c-means (Bezdek, 1981) clustering method in the space of the chord distance was used. Fuzzy clustering allowed the identification of both the relevés that were clearly assigned to a plant community and the transitional relevés (Wiser *et al*., 2013). In the present study, the fuzziness coefficient 'm' was set to 1.25, and the number of groups, as 'mobile centres', to 5, with the initial centre (seeds) as the centroid derived from a preliminary hierarchic cluster analysis (i.e., chord distance, complete linkage). Phytosociological relevés with fuzzy membership values ≥0.5 were considered as clearly assigned to a plant community.

Furthermore, non-metric multidimensional scaling (NMDS) ordering in the chord space was carried out, to highlight the main trends of the floristic variation. The fuzzy cluster analysis results were overlaid on the NMDS plot (Fig. 2).

The vegetation analysis was performed using the R software (R Core Team, 2012). The 'vegan' (Oksanen *et al*., 2013) and 'Vegclust' (De Cáceres *et al*., 2010) packages were used for the NMDS and fuzzy cluster analysis, respectively.

Results

Vegetation analysis

Despite the limited size of the area, an accurate analysis of the forest vegetation allowed the identification of a larger diversity of forest coenoses than has been previously highlited (Taffetani *et al*., 2004). In particular, this data analysis allowed better interpretation of the plant communities characterised by *T. baccata* and *I. aquifolium*.

All of 34 phytosociological relevés have fuzzy membership ≥0.5, showing clear separation among the five clusters, for both the floristic and structural terms. Also, the NMDS ordering highlights the distinction in terms of the floristic similarity of the five different plant communities. The NMDS with two dimensions, NMDS1 and NMDS2, showed the good fit of the phytosociological relevés in the chord space, with a streesplot of 0.12 (Podani, 2007).

The NMDS1 axis represents the topographic-morphological trend from the open slope with beech forest, to the upper slope and flat summit area with *Quercus cerris* woods. The NMDS2 axis represents the mesohygrophilus trend from the *Ulmus glabra* vegetation (Fig. 2, group 4), the *T. baccata* wood (Fig. 2, group 2) to the warmest and sunniest slopes with *Ostrya carpinifolia* forest.

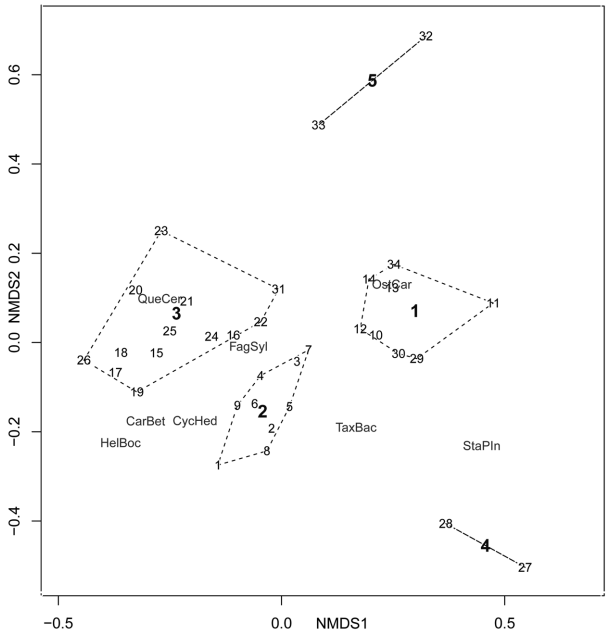

Fig. 2 - NMDS plot of the chord-transformed vegetation abundance data (stressplot = 0.12). Dashed lines represent the group derived from the fuzzy cluster analysis. Legend: QueCer, *Quercus cerris*; FagSyl, *Fagus sylvatica*; CarBet, *Carpinus betulus*; HelBoc, *Helleborus bocconei*; CycHed, *Cyclamen hederifolium*; TaxBac, *Taxus baccata*; OstCar, *Ostrya carpinifolia*; StaPin, *Staphylea pinnata*.

Vegetation typologies

WHITE OAK WOODS

ROSO SEMPERVIRENTIS-QUERCETUM VIRGILIANAE Biondi 1986 corr. Biondi, Casavecchia & Pesaresi 2010, subass. *quercetosum virgilianae* Allegrezza *et al*. 2001, corr. Biondi, Casavecchia & Pesaresi 2010 (Table 1).

Within the boundaries of the Macchia delle Tassinete SIC, there are two small nuclei of xerophilus forest that is dominated by the white oak (*Quercus virgiliana*). These are characterised by Mediterranean and sub-Mediterranean species that develop on calcareous

Tab.1 - *Roso sempervirentis-Quercetum virgilianae* Biondi 1986 corr. Biondi, Casavecchia & Pesaresi 2010 subass. *quercetosum virgilianae* Allegrezza *et al*. 2001 corr. Biondi, Casavecchia & Pesaresi 2010.

Relevé number	1
Altitude (m a.s.l.)	646
Exposure	E-SE
Slope (°)	25°
Area (m^2)	80
Coverage (%)	90%
Char. and diff. species of the ass. *Roso sempervirentis-Quercetum virgilianae*	
Quercus virgiliana (Ten.) Ten.	4.5
Smilax aspera L.	3.4
Cotinus coggygria Scop.	3.4
Asparagus acutifolius L.	2.2
Rubia peregrina L.	1.2
Lonicera etrusca Santi	1.2
Rosa sempervirens L.	1.1
Cytisophyllum sessilifolium (L.) O. Lang.	+.2
Char. species of the suball. *Lauro-Quercenion*, the all. *Carpinion orientalis*, the order *Quercetalia,*and the class *Querco-Fagetea*	
Acer monspessulanum L.	3.3
Fraxinus ornus L.	2.3
Cornus mas L.	1.2
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	1.2
Ostrya carpinifolia Scop.	1.1
Stachys officinalis (L.) Trevisan subsp. officinalis	1.1
Sorbus aria (L.) Crantz	1.1
Ruscus aculeatus L.	+.2
Sorbus domestica L.	+
Acer opalus Mill. subsp. obtusatum (Waldst.et Kit.ex Willd.) Gams	+
Other species	
Osyris alba L.	3.3
Brachypodium rupestre (Host) R. et S.	1.2
Juniperus oxycedrus L.	1.2
Dactylis glomerata L.	+.2
Hippocrepis emerus (L.) Lassen subsp.emeroides (Boiss. et Spruner) Lassen	+

and marly-calcareous substrates. These forest ecosystems are not very well laid out, with little tree cover and reduced presence of nemoral species, while species of the classes *Rhamno-Prunetea* and *Festuco-Brometea* are abundant. These two forest nuclei occur in the most thermophilus part of the study area (Upper mesotemperate isobioclimate), which is characterised by arid soils and a dry atmosphere.

These forests are a mature stage of the edapho-xerophilus, neutral-basophilus series of the white oak, and are dynamically linked with red juniper shrubs of the association *Junipero oxycedri-Cotinetum coggygriae*. Chain contacts are established with hornbeam woods of the association *Scutellario columnae-Ostryetum carpinifoliae*, and with shrublands of the *Spartium junceum* variant of the association *Spartio juncei-Cytisetum sessilifolii*.

HORNBEAM WOODS

SCUTELLARIO COLUMNAE-OSTRYETUM CARPINIFOLIAE Pedrotti, Ballelli & Biondi ex Pedrotti, Ballelli, Biondi, Cortini & Orsomando 1980 (Table 2; Fig. 2, group 5).

These are mixed deciduous forests that are dominated by *O. carpinifolia* and characterised by the presence in the tree layer of *Fraxinus ornus, Cornus mas, Quercus pubescens* and several species of the order *Fagetalia*, such *Euonymus latifolius, Sorbus aria, Prunus avium* and *Carpinus betulus*, which highlight the mesophilus character of this community. These forests are generally coppices, a practice that fosters the hornbeam, through its ability to form shoots.

This kind of wood is the mature stage of the climatophilus, neutral-basophilus series of the hornbeam, and it is dynamically linked with shrublands of the *S. junceum* variant of the association *Spartio juncei-Cytise-*

Tab.2 - *Scutellario columnae-Ostryetum carpinifoliae* Pedrotti, Biondi & Ballelli ex Pedrotti, Ballelli, Biondi, Cortini & Orsomando 1980

Relevé number	1	2	
Relevé number in Fig. 2	32	33	
Altitude (m a.s.l.)	615	600	
Exposure	NW	NW	
Slope (°)	35	40	
Area (m^2)	70	100	
Coverage (%)	9500%	100	Presences
Char. and diff. species of the ass. *Scutellario columnae-Ostryetum carpinifoliae*			
Ostrya carpinifolia Scop.	3.3	4.4	2
Fraxinus ornus L.	2.3	1.1	2
Scutellaria columnae All.	+	.	1
Char. and diff. species of the suball. *Laburno anagyroidis-Ostryenion carpinifoliae*, the all. *Carpinion orientalis* and the order *Quercetalia*			
Acer monspessulanum L.	2.2	1.1	2
Lithospermum purpurocaeruleum L.	1.2	.	1
Quercus pubescens Willd.	1.2	.	1
Melittis melissophyllum L.	+	.	1
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	.	1.1	1
Laburnum anagyroides Medicus	.	+	1
Char. species of the order *Fagetalia sylvaticae*			
Cornus mas L.	1.2	2.2	2
Euonymus latifolius (L.) Miller	+	2.2	2
Taxus baccata L.	+.2	.	1
Crataegus laevigata (Poir.) DC.	.	1.1	1
Corylus avellana L.	.	1.1	1
Rosa arvensis Hudson	.	1.1	1
Festuca heterophylla Lam.	.	+.2	1
Euphorbia dulcis L.	.	+.2	1
Fagus sylvatica L.	.	+	1
Milium effusum L.	.	+	1
Cruciata glabra (L.) Ehrend.	.	+	1
Char. species of the class *Querco-Fagetea*			
Acer opalus Mill. subsp. obtusatum (Waldst.et Kit.ex Willd.) Gams	1.1	1.1	2
Ruscus aculeatus L.	1.2	2.2	2
Quercus cerris L.	2.2	+	2
Melica uniflora Retz.	+.2	2.2	2
Hedera helix L. subsp. helix	+.2	+	2
Acer campestre L.	+	1.2	2
Lathyrus venetus (Miller) Wohlf.	+	1.2	2
Sorbus aria (L.) Crantz	+	1.1	2
Sorbus domestica L.	+	.	1
Hepatica nobilis Miller	.	2.2	1
Lonicera xylosteum L.	.	2.2	1
Campanula trachelium L.	.	1.2	1
Cephalanthera longifolia (Hudson) Fritsch	.	+.2	1
Daphne laureola L.	.	+	1
Carex digitata L.	.	+	1
Solidago virgaurea L.	.	+	1
Other species			
Asplenium onopteris L.	1.2	+	2
Ligustrum vulgare L.	1.2	+	2
Rubia peregrina L.	1.1	+	2
Crataegus monogyna Jacq.	+	2.2	2
Rubus ulmifolius Schott	1.2	.	1
Hippocrepis emerus (L.) Lassen subsp.emeroides (Boiss. et Spruner) Lassen	+.2	.	1
Cotinus coggygria Scop.	+.2	.	1
Helleborus foetidus L.	+.2	.	1
Prunella vulgaris L.	+.2	.	1
Bupleurum falcatum L.	+	.	1
Prunus spinosa L.	.	1.1	1
Fragaria vesca L.	.	+	1
Polypodium vulgare L.	.	+	1
Cytisophyllum sessilifolium (L.) O. Lang.	.	+	1

tum sessilifolii, and with grasslands of the association *Centaureo bracteatae-Brometum erecti*. Chain relationships are established with elements of the xerophilus series of *Q. virgiliana* (*Roso sempervirentis-Querco virgilianae* sigmetum), with those of the edapho-mesophilus series of the beech (*Asparago acutifolii-Fago sylvaticae* sigmetum), with the edapho-mesophilus series of the yew (*Staphyleo pinnatae-Taxo baccatae* sigmetum), and with the edapho-hygrophilus series of *Corylus avellana* (*Carpino betuli-Corylo avellanae* sigmetum). The hornbeam wood is located on the upper parts of the slope, where it is less affected by shading and by the air humidity. This area is characterised by the upper mesotemperate bioclimate, because of the change in exposure, and the hornbeam wood substitutes the beech wood. In the areas closest to the beech forest, *T. baccata* is more common, while it becomes more sporadic in the sunnier and drier areas.

BEECH WOODS

The morphology of the valley of the Fosso delle Scalette promotes the entry of humid winds from the sea and northerly winds, and persistent conditions of shade, thus creating a cool microclimate and moisture accumulation within the valley. Under these conditions, in the initial part of this river valley, on the W-NW-facing side, there is a low altitude beech wood. This is an 'Atlantic' beech wood, in which the yew is one of the characteristic species. In the area immediately below Villa Tassinete, in a small ravine, the yew population forms a real yew wood. Compared to other enclaves with yew in the central-southern Apennines, the Tassinete woods (Bosco delle Tassinete) is definitely one of the largest and easternmost areas of refuge. In comparison to previous studies carried out on the yew woods in the same area (Biondi, 1982; Taffetani *et al*., 2004; Ubaldi, 1995, 2003; Ubaldi *et al*. 1990), we describe here greater diversification of the mesophilus vegetation of the valley of Fosso delle Scalette, due to the presence of *T. baccata* in different kinds of woods. Furthermore, we have changed the syntaxonomical attribution of these woods, to include them in the order *Fagetalia sylvaticae*, rather than in the order *Quercetalia pubescenti-petraeae*.

The yew wood of Fosso delle Scalette was described by Biondi (1982) and attributed to the association *Taxo-Fagetum* Etter 1947, for which Biondi (1982) suggested an "Apennine race", differentiated by species of the association *Scutellario-Ostryetum*. This thus highlighted the importance of the species of the alliance *Carpinion orientalis* for this coenosis. In 1990, the same relevés were attributed to the new association *Taxo baccatae-Ostryetum carpinifoliae* (Ubaldi *et al*., 1990), which were later typified by the same author (Ubaldi, 1995) and classified in the order *Fagetalia* (Taffetani *et al*., 2004). Other studies considered the association *Taxo baccatae-Ostryetum carpinifoliae,* synonymous of the *T. baccata* variant of the association *Scutellario columnae-Ostryetum carpinifoliae* (Abbate *et al*., 2003; Ubaldi, 2003).

ASPARAGO ACUTIFOLII-FAGETUM SYLVATICAE ass. nova *hoc loco* (*Holotypus* relevé n. 1 of Table 3; Fig. 2, group 1).

We propose here a new association named *Asparago acutifolii-Fagetum sylvaticae*, which describes beech forests of low altitude. This community occurs in areas characterised by a high humidity of the atmosphere and the soil, as indicated by the oceanic species, such as *T. baccata*, *Ilex aquifolium*, *Daphne laureola, Ruscus aculeatus* and *C. betulus* that occur at very high coverage values.

Indeed, the 'oceanic' feature of the Macchia delle Tassinete community distinguishes it from other beech forests that occur on limestone at low altitude in central Italy, such as the associations *Staphyleo pinnatae-Fagetum sylvaticae, Lathyro veneti-Fagetum sylvaticae* and *Potentillo micranthae-Fagetum sylvaticae*, in which the characteristic species of the new association, the yew and the holly, are missing or are very sporadic. In addition to species of the order *Fagetalia*, a rich group of species of the order *Quercetalia* is present. For the species chorology, there are many species of the Mediterranean area.

This forest typology is relatively common in the Atlantic European countries, where it occurs at very low altitudes, even less than 300 m, and where the climate is characterised by abundant rainfall and cool summer temperatures. In western and north-western France, different associations of lowland forest have been described, such as *Ilici-Fagetum, Endymio-Fagetum* and *Rusco-Fagetum* (Durin *et al*., 1967). In the first two of these associations, which occur on limestone, *I. aquifolium* is always present, while *T. baccata* is rare or absent (Lalanne *et al*., 2010). The association *Rusco-Fagetum* occurs on acid substrates and *Taxus* , *Ilex* and *R. aculeatus* are always present (Durin *et al*., 1967).

The characteristic species of the association *Asparago acutifolii-Fagetum sylvaticae* are: *Fagus sylvatica, Asparagus acutifolius, Acer opalus* subsp. *obtusatum, Ruscus aculeatus, Ilex aquifolium, Fraxinus ornus, Taxus baccata, Daphne laureola, Rubia peregrina, Viola alba* subsp. *dehnhardtii* and *Ruscus hypoglossum*.

YEW WOODS

STAPHYLEO PINNATAE-TAXETUM BACCATAE ass. nova *hoc loco* (*Holotypus* relevé n. 4 of Table 4; Fig. 2, group 2).

Only in the ravine under Villa Tassinete, the beech fo-

Tab. 3 - *Asparago acutifolii-Fagetum sylvaticae* ass. nova (*holotypus* rel. n. 1).

Relevé number	1*	2	3	4	5	6	7	8	9	
Relevé number in Fig. 2	10	11	12	13	14	29	30	31	34	
Altitude (m a.s.l.)	660	657	690	650	630	660	690	660	600	
Exposure	N-NW	W-NW	N-NW	W-NW	W-NW	N-NW	N-NW	NW	N-NW	
Slope (°)	45	40	45	50	40	45	45	30	40	
Area (m^2)	100	120	150	100	80	80	100	100	100	
Coverage (%)	100	100	100	100	100	100	100	100	100	Presences
Char. and diff. species of the ass. *Asparago acutifolii-Fagetum sylvaticae*										
Fagus sylvatica L.	4.4	2.2	3.4	4.4	3.3	2.2	1.2	2.2	2.2	9
Acer opalus Mill. subsp. obtusatum (Waldst.et Kit.ex Willd.) Gams	3.3	2.3	3.3	4.4	2.2	3.3	3.3	3.4	2.2	9
Ilex aquifolium L.	1.1	1.2	2.2	2.2	2.2	+	1.1	1.2	+	9
Ruscus aculeatus L.	1.2	1.1	1.2	3.3	2.2	1.1	1.1	+	2.2	9
Fraxinus ornus L.	1.2	1.2	2.2	3.3	3.3	+	1.1	3.3	4.4	9
Taxus baccata L.	1.2	1.2	1.1	+	+	3.3	2.2	1.1	+	9
Daphne laureola L.	1.1	+	+.2	+	+	1.1	+.2	+	+	9
Asparagus acutifolius L.	+.2	+.2	+	1.1	1.1	+.2	+	+	1.1	9
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	+.2	+	+	+.2	+	+.2	+	+	1.1	9
Rubia peregrina L.	1.2	+.2	+.2	.	+	1.2	+.2	+	+	8
Ruscus hypoglossum L.	+.2	+	.	.	.	+	+	.	+	5
Diff. species of the new suballiance *Lathyro veneti-Fagenion*										
Ostrya carpinifolia Scop.	3.3	+.2	2.2	2.2	2.2	3.3	2.2	3.4	3.3	9
Sorbus aria (L.) Crantz	1.2	2.2	1.2	2.2	2.2	1.2	1.2	2.2	1.1	9
Melittis melissophyllum L.	+	+	+	+	+	+	+	+.2	1.1	9
Staphylea pinnata L.	2.2	1.2	1.2	1.1	1.1	1.2	+.2	.	+.2	8
Galanthus nivalis L.	+.2	.	+.2	.	.	+.2	+.2	+.2	.	5
Scilla bifolia L.	+.2	.	+.2	.	.	+.2	+.2	+.2	.	5
Corydalis cava (L.) Schweigg. et Koerte	.	.	.	.	.	+	+	+.2	.	3
Lathyrus venetus (Miller) Wohlf.	.	.	.	+	.	.	.	1.2	.	2
Cyclamen hederifolium Aiton	.	.	.	.	.	.	.	+.2	.	1
Char. and diff. species of the alliance *Aremonio-Fagion* and the order *Fagetalia sylvaticae*										
Euonymus latifolius (L.) Miller	1.1	+	2.2	1.1	1.1	1.1	2.2	1.2	1.1	9
Cornus mas L.	1.2	.	+	+	+	1.1	+	2.2	1.1	8
Rosa arvensis Hudson	.	.	.	+	+	.	.	1.1	+	4
Brachypodium sylvaticum (Hudson) Beauv.	.	.	.	.	+	.	.	1.1	+	3
Hordelymus europaeus (L.) Harz	.	.	+	.	.	.	+	.	.	2
Acer pseudoplatanus L.	.	.	.	.	+	.	.	.	+	2
Cardamine enneaphyllos (L.) Crantz	.	.	.	.	.	.	+.2	+	.	2
Luzula sylvatica (Hudson) Gaudin	.	.	.	.	.	.	+	.	.	1
Carpinus betulus L.	.	.	.	.	.	.	.	1.2	.	1
Festuca heterophylla Lam.	.	.	.	.	.	.	.	1.2	.	1
Char. species of the class *Querco-Fagetea*										
Hedera helix L. subsp. helix	2.3	+.2	2.2	1.1	2.2	2.3	2.2	1.1	1.1	9
Hepatica nobilis Miller	1.2	+.2	1.2	1.1	1.1	1.2	1.2	2.2	1.1	9
Rubus caesius L.	2.2	+	1.2	1.1	1.1	2.2	1.2	1.2	+	9
Sorbus torminalis (L.) Crantz	2.2	+.2	1.2	+	+	2.2	1.1	+.2	1.1	9
Cephalanthera longifolia (Hudson) Fritsch	+.2	+	+.2	+	1.1	+.2	+.2	.	+	8
Campanula trachelium L.	+	+	+	.	+	+	+	+	+	8
Mercurialis perennis L.	1.1	1.1	+	1.2	.	+	+	.	+	7
Corylus avellana L.	1.2	.	+.2	.	1.1	1.1	+.2	3.3	1.1	7
Solidago virgaurea L.	+	+	.	+.2	+	+	.	+.2	+	7
Carex digitata L.	+.2	.	+.2	+	+	+	+	.	+	7
Euphorbia amygdaloides L. subsp. amygdaloides	1.2	.	+.2	+.2	+	+.2	+.2	.	+	7
Laburnum anagyroides Medicus	+.2	+	.	+	.	+.2	.	+	+	6
Quercus cerris L.	+	.	+	+	+	.	+	+	.	6
Tamus communis L.	.	+	.	1.1	+	+	+	.	+	6
Lonicera xylosteum L.	+	+	.	.	.	+	.	1.2	+	5
Sorbus domestica L.	+	.	+	1.1	.	+	+	.	.	5
Primula vulgaris Hudson	+.2	.	+.2	.	.	+	+	+.2	.	5
Cercis siliquastrum L.	.	+	.	+	+	.	.	.	+	4
Melica uniflora Retz.	.	.	+.2	.	.	.	+.2	1.1	1.1	4
Viola reichenbachiana Jordan ex Boreau	.	.	+.2	.	.	.	+	+.2	.	3
Quercus pubescens Willd.	.	+	.	+	.	.	.	+	.	3
Hieracium sylvaticum (L.) L.	.	.	.	+.2	.	.	.	+.2	+	3
Sanicula europaea L.	+	.	.	.	.	+	.	.	.	2
Lilium bulbiferum L. ssp. croceum (Chaix) Baker	.	.	.	.	+	.	.	.	.	1
Scutellaria columnae All.	.	.	.	.	.	.	.	+.2	.	1
Acer campestre L.	.	.	.	.	.	.	.	+	.	1
Clematis vitalba L.	.	.	.	.	.	.	.	+	.	1
Stachys officinalis (L.) Trevisan subsp. officinalis	.	.	.	.	.	.	.	+	.	1
Lithospermum purpurocaeruleum L.	.	.	.	.	.	.	.	.	+	1
Other species										
Carex flacca Schreber ssp. serrulata (Biv.) Greuter	1.1	1.2	+.2	.	.	1.1	+.2	1.1	1.1	7
Crataegus monogyna Jacq.	.	+	+	1.1	1.1	.	+	1.1	1.1	7
Hippocrepis emerus (L.) Lassen subsp.emeroides (Boiss. et Spruner) Lassen	+.2	+	.	+	+	+.2	.	+	+	7
Epipactis helleborine (L.) Crantz	+	+	+	.	.	+	+	.	.	5
Crataegus laevigata (Poir.) DC.	1.2	.	1.2	.	.	1.1	1.1	2.2	.	5
Fragaria vesca L.	+.2	.	+	.	.	+.2	+	+.2	.	5
Ligustrum vulgare L.	+	+	.	.	.	+	.	+	.	4
Osyris alba L.	.	2.2	.	+	+	.	.	.	.	3
Accidental species	1	2	0	0	1	4	2	3	2	

rest changes its structure. Here it assumes the character of a true yew wood, in which in addition to many adult yew trees, there is strong renewal of the yew.

The phytosociological relevés carried out for the present study were compared with those from the same area that were carried out about 30 years ago (Biondi, 1982). At the time, the physionomy of the wood was due to hornbeam, although yew, beech and holly were present, and for this reason this wood was attributed to the order *Quercetalia pubescenti-petraeae* and to the association *Taxo-Ostryetum* (Ubaldi *et al*., 1990; Ubaldi, 1995) or to the *T. baccata* variant of the *Scutellario columnae-Ostryetum carpinifoliae* (Abbate *et al*., 2003; Ubaldi, 2003).

Currently, for the site originally described by Biondi (1982), the association *Taxo-Ostyetum* no longer exists, because the cenosis has evolved into a forest that is dominated by yew, therefore the wood is now attributed to the new association *Staphyleo-Taxetum* that we propose here. Due to the strong renewal of the yew, the evolution of this plant community demonstrates the potentiality of the yew wood in this area. The characteristic species of the association *Staphylaeo pinnatae-Taxetum baccatae* are: *Taxus baccata*, *Staphylea pinnata, Ruscus aculeatus, Ilex aquifolium, Cyclamen hederifolium* and *Ruscus hypoglossum*.

LATHYRO VENETI-FAGENION SYLVATICAE suball. nova (*Holotypus* association: *Lathyro veneti-Fagetum sylvaticae* Biondi *et al*. ex Biondi, Casavecchia, Pinzi, Allegrezza & Baldoni in Biondi, Allegrezza, Casavecchia, Galdenzi, Gigante & Pesaresi 2013)

We propose the attribution of the two new associations *Staphyleo pinnatae-Taxetum baccatae* and *Asparago acutifolii-Fagetum sylvaticae* to a new suballiance of the name *Lathyro veneti-Fagenion sylvaticae*. This new suballiance groups together the low altitude beech forests of the central Apennines on different kinds of calcareous substrata (Temperate macrobioclimate, sub-Mediterranean variant; thermotype varying from Upper mesotemperate to lower supratemperate; ombrotype from sub-humid to humid).

These beech forests occur at altitudes between 600 m and 1200 m a.s.l., and they represent the transition between the forests dominated by *O. carpinifolia* of the suballiance *Laburno-Ostryenion* and the montane beech forests of the suballiance *Cardamino kitaibelii-Fagenion sylvaticae* (Biondi *et al*., 2002). The new suballiance is temporarily attributed to the Illirian-Balkan alliance *Aremonio agrimonioidis-Fagion sylvaticae*, even though most of the characteristic species of this syntaxon are absent in the central and central-northern Apennines (Marincek *et al*., 1982).

We propose the association *Lathyro veneti-Fagetum sylvaticae* as the type of the new suballiance. The new suballiance groups together the low altitudes beech forests that were previously attributed to the southern alliance *Geranio versicoloris-Fagion sylvaticae*. The associations are: *Lathyro veneti-Fagetum sylvaticae; Hieracio racemosi-Fagetum sylvaticae* (Allegrezza, 2003); *Staphyleo pinnatae-Fagetum sylvaticae* (Ubaldi, 1995); *Potentillo micranthae-Fagetum sylvaticae* (Biondi *et al*., 2008); *Dactylorhizo fuchsii-Fagetum sylvaticae* (Biondi *et al*.1989) and others.

The differential species of the suballiance are: *Lathyrus venetus, C. hederifolium, Sorbus aria, Viola alba* subsp. *dehnhardtii, Galanthus nivalis, Corydalis cava, Scilla bifolia, O. carpinifolia, Melittis melissophyllum* and *Staphylaea pinnata*.

WYCH ELM AND EUROPEAN ASH WOODS

ULMUS GLABRA AND *FRAXINUS EXCELSIOR* COMMUNITY (Tab. 5; group 4 in Fig. 2)

These are mesophilus forests that occur in small ravines along the slopes. The tree layer is dominated by *Acer opalus* subsp. *obtusatum, S. pinnata, U. glabra* and *F. excelsior*, with *T. baccata* and *C. betulus*. These formations are in chain contact with the beech wood with yew (*Asparago acutifolii-Fagetum sylvaticae*), with the hornbeam woods (*Scutellario columnae-Ostryetum carpinifoliae*) and with the woods of hazel and hornbeam (*Carpino betuli-Coryletum avellanae*). This plant community is attributed to the suballiance *Lathyro veneti-Fagenion*.

TURKEY OAK WOODS

TAXO BACCATAE-QUERCETUM CERRIS ass. nova *hoc loco* (*holotypus* relevé n. 22 Table 6; Fig. 2, group 3)

On the top and the flat area of Macchia delle Tassinete, the beech wood degrades into a mesophilus turkey oak wood, where several species of *Fagetalia* occur, among which *T. baccata* and *I. aquifolium* are particularly abundant.

This mesophilus community was compared with those reported in Marche and the neighbouring regions (i.e., *Melico uniflorae-Quercetum cerris, Carici sylvaticae-Quercetum cerris, Centaureo montanae-Carpinetum betuli, Cytiso villosi-Quercetum cerris, Listero ovatae-Quercetum cerris, Aremonio agrimonioidis-Quercetum cerris* and *Salvio glutinosae-Quercetum cerris*). This comparison showed particular resemblance to the association *Carici sylvaticae-Quercetum cerris*. However, the floristic and ecological analysis highlights important differences between these two communities. The turkey oak wood in the Tassinete area is very strongly influenced by the atmospheric moisture, and therefore it appears as a forest with a

Tab. 4 - *Staphyleo pinnatae-Taxetum baccatae* ass. nova (*Holotypus* rel. n. 4)

Relevé number	1	2	3	4*	5	6	7	8	9	
Relevé number in Fig. 2	5	9	8	4	1	6	7	3	2	
Altitude (m a.s.l.)	665	670	675	764	590	687	705	650	679	
Exposure	N-NW	NW	NW	W-NW	N-NE	E-NE	NW	N	NW	
Slope (°)	30	25	20	25	10	15	20	25	20	
Area (m²)	100	100	100	600	200	400	400	300	400	
Coverage (%)	100	100	100	100	100	100	100	100	100	Presences
Char. and diff. species of the ass. *Staphyleo pinnatae-Taxetum baccatae*										
Taxus baccata L.	2.2	2.2	3.3	4.4	4.5	4.5	3.4	4.5	4.5	9
Ruscus aculeatus L.	1.2	1.2	+.2	4.4	1.2	2.3	2.3	4.4	1.2	9
Ilex aquifolium L.	2.3	1.2	1.2	3.3	2.3	2.2	2.3	2.2	1.2	9
Cyclamen hederifolium Aiton	+.2	1.2	1.2	1.2	1.2	1.2	1.2	.	1.2	8
Staphylea pinnata L.	1.2	.	.	1.2	.	1.2	2.3	2.3	1.2	6
Ruscus hypoglossum L.	.	.	.	+	.	.	+	.	.	2
Diff. species of the new suballiance *Lathyro veneti-Fagenion*										
Fraxinus ornus L.	1.1	+	1.1	1.2	2.3	2.2	3.3	3.3	+.2	9
Ostrya carpinifolia Scop.	1.2	1.1	1.2	1.2	1.2	2.3	4.5	2.3	3.3	9
Sorbus aria (L.) Crantz	+	.	+	1.2	.	.	1.2	1.2	+.2	6
Lathyrus venetus (Miller) Wohlf.	+	+	+	.	+	.	.	.	.	4
Melittis melissophyllum L.	+.2	1.1	.	.	.	.	+.2	.	+	4
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	.	.	.	.	+	.	.	1.2	+	3
Char. and diff. species of the all. *Aremonio-Fagion* and the order *Fagetalia sylvaticae*										
Fagus sylvatica L.	4.4	2.2	1.2	4.5	1.2	3.3	2.2	5.5	3.3	9
Corylus avellana L.	1.2	1.2	1.2	2.2	2.2	2.2	2.2	2.2	3.3	9
Euonymus latifolius (L.) Miller	2.2	1.1	+	2.3	+	+	1.2	2.2	2.2	9
Rosa arvensis Hudson	+	1.1	+	1.2	2.3	1.2	1.2	2.2	+	9
Carpinus betulus L.	2.3	2.3	2.2	2.3	3.4	2.2	1.2	2.3	4.4	9
Cornus mas L.	+	+	+	2.3	+.2	1.2	2.3	1.2	.	8
Festuca heterophylla Lam.	+.2	+.2	+.2	.	.	+	.	.	.	4
Lilium martagon L.	+	.	.	.	.	.	1.1	.	+	3
Tilia platyphyllos Scop.	.	.	.	+	.	.	+	.	1.2	3
Galium odoratum (L.) Scop.	+.2	.	.	.	+.2	.	.	.	.	2
Mycelis muralis (L.) Dumort.	.	.	.	.	+	.	.	.	+	2
Lathyrus vernus (L.) Bernh.	.	.	.	.	.	.	+.2	.	1.2	2
Euphorbia dulcis L.	.	.	.	.	.	+	.	.	.	1
Hordelymus europaeus (L.) Harz	.	.	.	.	.	.	+	.	.	1
Potentilla micrantha Ramond	.	.	.	.	.	.	+	.	.	1
Abies alba Miller	.	.	.	.	.	.	.	.	1.2	1
Char. species of the class *Querco-Fagetea*										
Acer opalus Mill. subsp. obtusatum (Waldst.et Kit.ex Willd.) Gams	2.2	2.2	3.3	3.4	4.5	4.5	3.4	4.4	4.5	9
Hedera helix L. subsp. helix	+.2	2.2	2.3	1.2	1.2	2.3	2.2	1.2	3.4	9
Hepatica nobilis Miller	+.2	+.2	1.2	1.2	1.2	1.1	2.2	2.2	2.2	9
Quercus cerris L.	+	1.1	1.1	3.4	1.2	3.4	2.2	1.2	2.2	9
Mercurialis perennis L.	1.2	+	+.2	2.3	+.2	2.2	2.3	2.3	3.4	9
Viola reichenbachiana Jordan ex Boreau	+	+.2	+.2	1.2	1.2	+	1.2	1.2	1.2	9
Daphne laureola L.	+.2	+	+	1.2	+	1.1	1.1	.	+	8
Melica uniflora Retz.	+.2	+.2	+.2	1.2	1.2	.	1.2	1.2	1.1	8
Euphorbia amygdaloides L. subsp. amygdaloides	+.2	+.2	.	2.2	1.2	.	.	2.2	+	6
Rubus caesius L.	1.1	1.2	.	3.3	2.2	2.3	3.3	2.3	4.5	8
Brachypodium sylvaticum (Hudson) Beauv.	+.2	+.2	+.2	1.2	.	.	.	2.2	.	5
Sorbus torminalis (L.) Crantz	+	+	+	.	.	.	+	2.2	+	6
Sanicula europaea L.	+.2	+.2	.	.	2.3	+	.	+	2.3	6
Solidago virgaurea L.	+	+	.	.	.	+	.	1.1	+	5
Acer campestre L.	+	+	1.1	.	.	1.2	.	.	1.2	5
Primula vulgaris Hudson	.	.	.	.	2.2	+.2	1.1	.	+	4
Carex digitata L.	+.2	.	.	.	+.2	.	1.2	.	1.2	4
Iris foetidissima L.	+	1.1	.	.	1.2	.	.	.	1.1	4
Inula conyza DC.	1.1	+	+	.	.	.	.	.	.	3
Hieracium sylvaticum (L.) L.	+.2	.	.	.	.	+	.	+	.	3
Clematis vitalba L.	.	.	.	.	.	1.2	1.2	.	2.2	3
Prunus avium L.	+	.	.	.	.	1.2	.	.	.	2
Cephalanthera damasonium (Miller) Druce	+	.	.	.	.	.	.	.	+	2
Cephalanthera longifolia (Hudson) Fritsch	.	.	.	+	.	.	+	.	.	2
Lithospermum purpurocaeruleum L.	.	.	.	.	+	+	.	.	.	2
Quercus pubescens Willd.	.	.	.	.	1.2	.	1.2	.	.	2
Geum urbanum L.	.	.	.	.	+	.	.	+	.	2
Carex sylvatica Hudson	.	.	.	.	2.2	.	.	.	1.2	2
Stachys officinalis (L.) Trevisan subsp. officinalis	.	.	.	.	.	+	.	+	.	2
Laburnum anagyroides Medicus	+	.	.	.	.	.	.	.	.	1
Campanula trachelium L.	.	.	+	.	.	.	.	.	.	1
Tamus communis L.	.	.	.	+	.	.	.	.	.	1
Lilium bulbiferum L. ssp. croceum (Chaix) Baker	.	.	.	.	.	+	.	.	.	1
Scutellaria columnae All.	.	.	.	.	.	+	.	.	.	1
Sorbus domestica L.	.	.	.	.	.	.	.	.	+	1

Other species										
Lonicera xylosteum L.	1.1	+	+	2.2	1.2	2.2	1.2	+	1.2	9
Crataegus laevigata (Poir.) DC.	1.1	1.2	2.3	2.3	1.2	1.2	2.3	2.3	2.3	9
Crataegus monogyna Jacq.	+	1.1	1.1	.	+.2	.	+	1.2	+	7
Asparagus acutifolius L.	+	+	.	.	1.1	+	1.2	1.2	+	7
Helleborus bocconei Ten.	+.2	1.1	+	.	+	1.2	1.1	.	+	7
Cornus sanguinea L.	+	+	+	.	1.2	1.2	+.2	.	+.2	7
Ligustrum vulgare L.	+.2	1.2	1.2	.	1.2	+	+	.	.	6
Rubus ulmifolius Schott	+	+	+	.	.	.	.	.	.	3
Lonicera caprifolium L.	+	+	+	.	.	.	.	.	.	3
Helleborus foetidus L.	.	.	.	+	+	.	.	+	.	3
Ajuga reptans L.	.	.	.	.	1.2	.	+.2	.	+.2	3
Accidental species	3	3	1	1	1	3	2	5	2	

strong 'oceanic' aspect, which is demonstrated by the presence of *I. aquifolium*, and to a lesser extent, *T. baccata*. In contrast, the association *Carici sylvaticae-Quercetum cerris* is a montane forest that is richer in mesophilus species because of the greater humidity of the soil.

Indeed, the cluster analysis highlights that the two groups of relevés corresponding to these two communities separate at relatively low levels of similarity (Fig. 2). Therefore, we describe the new association *Taxo baccatae-Quercetum cerris* that is attributed to the alliance *Physospermo verticillati-Quercion cerris* and to the suballiance *Pulmonario apenninae-Carpinenion betuli*. The characteristic species of the new association are: *Quercus cerris, Cornus mas, Ilex aquifolium, Lonicera xylosteum* and *Taxus baccata*.

The association shows two different aspects: the typicum subassociation and the subassociation *fagetosum sylvaticae*, differentiated by *Fagus sylvatica, Carex sylvatica, Cardamine bulbifera, Acer pseudoplatanus* and *Luzula sylvatica*.

Tab.5 - *Ulmus glabra* and *Fraxinus excelsior* community.

Relevé number	1	2	
Relevé number in Fig. 2	27	28	
Altitude (m a.s.l.)	615	635	
Exposure	W-NW	W	Presences
Slope (°)	40	40	
Area (m²)	80	60	
Coverage (%)	100	100	
Char. and diff. species of the *Ulmus glabra* and *Fraxinus excelsior* community			
Fraxinus excelsior L.	2.2	1.2	2
Ulmus glabra Hudson	1.2	+	2
Diff. Species of the suball. *Lathyro veneti-Fagenion*			
Staphylea pinnata L.	3.3	2.3	2
Ostrya carpinifolia Scop.	2.2	1.2	2
Sorbus aria (L.) Crantz	1.1	+	2
Melittis melissophyllum L.	+	+	2
Lathyrus venetus (Miller) Wohlf.	+	+	2
Char. and diff. species of the all. *Aremonio-Fagion* and the order *Fagetalia sylvaticae*			
Euonymus latifolius (L.) Miller	2.3	1.1	2
Galium odoratum (L.) Scop.	2.2	1.2	2
Taxus baccata L.	2.2	1.2	2
Carpinus betulus L.	1.2	1.1	2
Ilex aquifolium L.	+.2	+.2	2
Corylus avellana L.	1.2	+	2
Mycelis muralis (L.) Dumort.	1.1	+	2
Acer pseudoplatanus L.	+	+	2
Lilium martagon L.	+	+	2
Brachypodium sylvaticum (Hudson) Beauv.	.	+.2	1
Fagus sylvatica L.	.	+	1
Euphorbia dulcis L.	.	+	1
Char. species of the class *Querco-Fagetea*			
Acer opalus Mill. subsp. obtusatum (Waldst.et Kit.ex Willd.) Gams	2.3	3.4	2
Lonicera xylosteum L.	2.2	1.1	2
Ruscus aculeatus L.	1.2	1.2	2
Hedera helix L. subsp. helix	1.2	1.2	2
Mercurialis perennis L.	1.2	2.2	2
Clematis vitalba L.	1.1	+	2
Melica uniflora Retz.	+.2	+.2	2
Viola reichenbachiana Jordan ex Boreau	+.2	+.2	2
Euphorbia amygdaloides L. subsp. amygdaloides	+.2	+	2
Laburnum anagyroides Medicus	+	+	2
Campanula trachelium L.	+	+	2
Daphne laureola L.	+	+	2
Tamus communis L.	+	+	2
Hepatica nobilis Miller	.	+.2	1
Other species			
Geranium robertianum L.	3.4	+.2	2
Rubus ulmifolius Schott	1.2	+	2
Asplenium onopteris L.	+.2	+.2	2
Rubia peregrina L.	+	+	2
Salvia glutinosa L.	1.2	.	1
Atropa belladonna L.	+.2	.	1

Conclusions

Although small, the study area is characterised by high biodiversity and originality of the forests. Indeed, the presence of the European yew provides a strong fingerprint for the different forest communities, which therefore differ in an original way compared to similar formations that are found in other parts of the region. This has, therefore, determined the need to describe new associations and subassociations of strong phytogeographical and conservational interest. Thus, this study contributes to the updating for the completion of the prodrome of the Italian vegetation (Biondi *et al*., 2014).

For the conservational management of this SCI area (IT 53330013), the different forest types are described as habitats sensu Directive 43/92 EEC (Biondi *et al*., 2012), some of which are reported for the first time in the SCI, as they are not included in the standard form.

Habitat 9580*: Mediterranean *Taxus baccata* woods

This habitat is currently indicated only for Calabria, Sicily and Sardinia, and it refers to *T. baccata* woods, often with *I. aquifolium*, that are located in small areas within deciduous woods formations, which are rarely evergreen.

With the present study, we propose to extend this Habitat also to the Marche region, referring to it the *T. baccata* wood, located in the small gorge at the southern limit of the SCI, and described as the new association *Staphyleo pinnatae-Taxetum baccatae*.

Tab. 6 - *Taxo baccatae-Quercetum cerris* ass. nova *hoc loco* (*Holotypus* rel. n. 3) subass. *typicum* (*holotypus* rel. 3) subass. *fagetosum sylvaticae* subass. nova (*holotypus* rel. n. 9).

Relevé number	1	2	3*	4	5	6	7	8	9**	10	11	12	
Relevé number in Fig. 2	20	21	22	23	24	17	15	16	19	18	25	26	
Atitude (m a.s.l.)	780	770	756	808	753	775	740	735	770	775	735	775	presences
Exposure	-	-	N	-	W-NW	-	NW	W-NW	-	-	-	-	
Slope (°)	-	-	15	-	5	-	5	10	-	-	-	-	
Area (m²)	150	340	300	330	420	120	120	150	120	120	150	120	
Coverage (%)	100	100	100	100	100	100	100	100	100	100	100	100	
Charact. and diff. species of the association *Taxo baccatae-Quercetum cerris*													
Quercus cerris L.	4.4	5.5	4.5	5.5	4.5	2.2	2.2	1.1	1.1	2.2	3.3	3.3	12
Cornus mas L.	1.2	2.2	2.3	3.3	2.3	+	+	+	1.1	+	+	+	12
Ilex aquifolium L.	+	2.2	1.2	4.5	2.3	2.2	1.1	2.2	1.1	+	2.2	1.1	12
Lonicera xylosteum L.	+	1.2	2.2	1.2	1.2	1.1	+	1.2	+	1.1	+	1.1	12
Taxus baccata L.	.	+	2.2	.	1.2	.	+	1.2	+	.	.	.	6
Diff. species of the subass. *fagetosum sylvaticae*													
Fagus sylvatica L.	2.2	2.3	3.4	2.2	2.2	4.4	4.4	3.3	3.3	2.2	3.3	2.2	12
Carex sylvatica Hudson	.	.	.	.	.	.	+	+	+	+	+	.	5
Cardamine bulbifera (L.) Crantz	.	.	.	.	.	1.1	.	.	1.1	+	.	1.1	4
Acer pseudoplatanus L.	.	.	.	.	.	.	+	.	+	+	.	+	4
Luzula sylvatica (Hudson) Gaudin	.	.	.	.	.	.	.	.	1.1	+	.	+	3
Charact. and diff. species of the alliance P*hysospermo verticillati-Quercion cerris* and of the suball. *Pulmonario apenninae-Carpinenion betuli*													
Carpinus betulus L.	3.3	3.4	2.3	2.2	2.3	3.3	1.2	2.2	2.2	2.2	1.1	3.3	12
Acer opalus Mill. subsp. obtusatum (Waldst.et Kit.ex Willd.) Gams	2.2	3.3	3.3	2.3	3.3	1.1	2.2	1.1	2.2	3.3	3.3	1.1	12
Rosa arvensis Hudson	1.1	3.4	2.3	2.3	3.3	2.2	1.1	+	2.2	2.2	1.1	2.2	12
Rubus caesius L.	+.2	3.3	3.3	2.3	3.4	1.1	3.3	3.3	1.1	2.2	2.2	1.1	12
Crataegus laevigata (Poir.) DC.	1.1	2.3	2.3	3.3	3.3	2.2	1.1	+	2.2	2.2	1.2	1.1	12
Daphne laureola L.	+	1.1	1.1	+	1.1	.	1.2	+	1.1	+	+	+	11
Euonymus latifolius (L.) Miller	+	1.2	2.3	1.2	1.2	.	.	+	+	.	.	.	7
Viola alba Besser ssp. dehnhardtii (Ten.) W. Becker	+.2	1.2	1.2	1.2	.	.	.	.	+	+	.	.	6
Acer campestre L.	1.1	1.2	.	.	1.2	.	.	.	.	.	+	+	5
Lilium bulbiferum L. ssp. croceum (Chaix) Baker	+	.	.	.	.	.	.	.	+	+	.	+	4
Pyrus pyraster Burgsd.	.	.	.	.	+	.	.	.	+	.	.	.	2
Charact species of the order *Fagetalia sylvaticae*													
Corylus avellana L.	3.4	3.3	2.2	3.4	3.3	2.2	3.3	1.2	2.2	3.3	3.3	1.1	12
Festuca heterophylla Lam.	+	2.2	1.2	1.2	1.2	+	.	+	+	+	1.2	+	11
Brachypodium sylvaticum (Hudson) Beauv.	.	2.2	1.2	.	1.2	+	+	+	+	+	.	+	9
Cruciata glabra (L.) Ehrend.	+.2	1.2	.	+	.	.	.	.	.	.	.	.	3
Staphylea pinnata L.	.	+	2.2	.	.	.	.	.	.	.	.	.	2
Euphorbia dulcis L.	.	+	.	.	.	.	.	.	+	.	.	.	2
Corydalis cava (L.) Schweigg. et Koerte	+.2	.	.	.	.	.	.	.	.	.	.	.	1
Potentilla micrantha Ramond	.	+	.	.	.	.	.	.	.	.	.	.	1
Ruscus hypoglossum L.	.	1.1	.	.	.	.	.	.	.	.	.	.	1
Lilium martagon L.	.	.	.	.	.	.	.	.	+	.	.	.	1
Tilia platyphyllos Scop.	.	.	.	.	.	.	.	.	+	.	.	.	1
Charact. species of the class *Querco-Fagetea*													
Fraxinus ornus L.	2.2	2.2	2.2	2.3	3.3	1.1	1.2	1.1	+	1.1	1.1	+	12
Hedera helix L. subsp. helix	+.2	2.2	1.2	1.2	2.3	+	1.2	2.2	+	+	1.1	+	12
Hepatica nobilis Miller	+.2	2.2	1.2	1.2	1.2	+	+	+	+	+	+	+	12
Ruscus aculeatus L.	+	2.2	3.4	.	2.2	+	+	+	+	+	+	+	11
Euphorbia amygdaloides L. subsp. amygdaloides	+.2	2.3	.	2.2	1.2	1.1	+	+	1.1	1.1	+	1.1	11
Sorbus aria (L.) Crantz	+	1.2	2.3	1.2	1.2	+	.	1.2	+	+	.	+	10
Lathyrus venetus (Miller) Wohlf.	+.2	1.2	.	.	1.2	+	+	+	1.1	1.1	+	+	10
Melica uniflora Retz.	+.2	1.2	.	.	2.2	+	+	+	+	+	+	+	10
Viola reichenbachiana Jordan ex Boreau	+	1.2	.	.	1.2	+	+	+	+	1.1	+	+	10
Ostrya carpinifolia Scop.	+.2	1.2	1.2	1.2	2.3	.	.	2.2	.	.	+	.	7
Iris foetidissima L.	+	+.2	.	.	.	+	.	.	+	+	+	+	7
Solidago virgaurea L.	.	1.2	+.2	1.2	1.2	.	.	.	.	+	+	+	7
Sorbus domestica L.	+	1.2	.	1.2	+	.	.	.	+	.	+	.	6
Cyclamen hederifolium Aiton	.	1.2	1.2	.	1.2	.	+	+	.	.	+	.	6
Mercurialis perennis L.	.	.	.	.	+.2	1.1	.	.	+	+	+	+	6
Primula vulgaris Hudson	+	.	.	.	.	+	.	.	+	+	.	+	5
Sorbus torminalis (L.) Crantz	.	1.2	1.2	2.2	.	+	.	.	+	.	.	.	5
Clematis vitalba L.	.	.	+.2	.	2.2	.	.	.	+	+	.	+	5
Carex digitata L.	+	.	.	.	.	.	+	+	.	.	+	.	4
Laburnum anagyroides Medicus	+	+.2	.	.	.	.	.	+	+	.	.	.	4
Quercus pubescens Willd.	.	2.3	.	2.2	.	.	+	.	.	.	.	+	4
Stachys officinalis (L.) Trevisan subsp. officinalis	.	2.2	.	.	.	.	.	.	+	+	.	+	4
Campanula trachelium L.	+	1.1	.	.	.	.	.	.	+	.	.	.	3
Sanicula europaea L.	+.2	.	.	.	1.2	.	.	.	+	.	.	.	3
Melittis melissophyllum L.	.	.	.	.	.	+	.	.	+	.	.	+	3
Cephalanthera damasonium (Miller) Druce	.	+	.	.	.	.	.	.	.	+	.	.	2
Cephalanthera longifolia (Hudson) Fritsch	.	+	.	.	.	.	.	.	.	.	+	.	2
Tamus communis L.	.	.	+	.	+	.	.	.	.	.	.	.	2
Hieracium sylvaticum (L.) L.	+	.	.	.	.	.	.	.	.	.	.	.	1
Scutellaria columnae All.	.	+	.	.	.	.	.	.	.	.	.	.	1
Inula conyza DC.	.	+	.	.	.	.	.	.	.	.	.	.	1
Lithospermum purpurocaeruleum L.	.	.	.	.	+	.	.	.	.	.	.	.	1

Other species													
Crataegus monogyna Jacq.	+.2	2.2	1.2	1.2	2.3	+	1.1	1.2	+	1.1	1.1	+	12
Fragaria vesca L.	+.2	.	.	.	.	+	.	+	+	+	+	+	7
Hippocrepis emerus (L.) Lassen subsp.emeroides (Boiss. et Spruner) Lassen	+	+.2	1.2	2.2	+	.	+	+	.	.	.	.	7
Carex flacca Schreber ssp. serrulata (Biv.) Greuter	.	1.2	2.2	2.2	.	.	.	.	+	+	+	+	7
Prunus spinosa L.	.	2.3	.	2.2	+	.	.	.	+	+	.	+	6
Cyclamen repandum S. et S.	1.1	.	.	.	.	1.1	.	.	1.1	1.1	.	+	5
Helleborus bocconei Ten.	.	.	.	.	.	+	.	.	+	+	+	1.1	5
Helleborus foetidus L.	+	1.2	.	.	+	.	.	.	.	.	1.1	.	4
Ajuga reptans L.	.	1.2	.	.	.	.	.	.	+	1.1	.	+	4
Pteridium aquilinum (L.) Kuhn	+	.	.	2.3	.	.	.	.	+	.	.	.	3
Cornus sanguinea L.	.	1.2	.	.	1.2	.	.	.	+	.	.	.	3
Cruciata laevipes Opiz	.	.	.	.	.	.	.	.	+	+	.	+	3
Accidental species	3	3	2	4	0	0	0	1	0	0	1	0	

Habitat 9210*: Apennine beech forests with *Taxus* and *Ilex*

The beech woods that are present throughout the mesophilus side of the Tassinete forest are described as the new association *Asparago acutifolii-Fagetum sylvaticae*, which is included in Habitat 9210*. This Habitat refers to the thermophilus Apennine beech forests with yew and holly in both the high-shrub layer and the shrub layer, which occur in the supratemperate bioclimatic belt and show ingression into the upper mesotemperate belt.

Habitat 91L0: Illyrian oak-hornbeam forests (*Erythronio-Carpinion*)

To the north of the study area, the mesophilus turkey oak woods that are attributed to the new association *Taxo baccatae-Quercetum cerris* can be referred to Habitat 91L0, which in peninsular Italy groups the mesophilus woods with turkey oak and European hornbeam, of the alliance *Physospermo verticillati-Quercion cerris*, the vicariant alliance of the Illyrian *Erythronio-Carpinion*.

Habitat 91AA*: Eastern white oak woods

The xerophilus woody coenoses of the association *Roso sempervirentis-Quercetum virgilianae* belong to Habitat 91AA*, which includes the Mediterranean and sub-Mediterranean woods of the Adriatic and Tyrrhenian sides of Italy that are dominated by *Quercus virgiliana, Q. dalechampii, Q. pubescens* and *F. ornus*. This Habitat is distributed throughout the Italian peninsula, from the northern to the southern regions, including Sicily, and has been widely reported in the Marche region, although not in the SCI included in the study area.

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Appendix I: Sporadic species

Tab. 3. Rel. n. 1: Helleborus foetidus L. +; Rel. n. 2: Cytisophyllum sessilifolium (L.) O. Lang. +, Bupleurum falcatum L. +; Rel. n. 5: Cytisophyllum sessilifolium (L.) O. Lang. +; Rel. n. 6: Helleborus foetidus L. +, Rubus ulmifolius Schott 1.1, Rosa canina L. sensu Bouleng. +.2, Glechoma hirsuta W. et K.+; Rel. n. 7: Rubus ulmifolius Schott +.2, Rosa canina L. sensu Bouleng. +; Rel. n. 8: Helleborus bocconei Ten. +, Polypodium vulgare L.+, Prunus spinosa L. +; Rel. n. 9: Cotinus coggygria Scop. +, Cyclamen repandum S. et S. +.

Tab. 4. Rel. n. 1: Polypodium vulgare L. +.2, Orobanche hederae Duby +.2, Epipactis helleborine (L.) Crantz +.2; Rel. n. 2: Rubia peregrina L. +, Polypodium vulgare L. +, Vicia sativa L. +; Rel. n. 3: Prunella vulgaris L.+; Rel. n. 4: Juniperus communis L. subsp. communis +; Rel. n. 5: Rubia peregrina L. 2.3; Rel. n. 6: Prunus spinosa L. +, Euonymus europaeus L. +, Glechoma hirsuta W. et K. +; Rel. n. 7: Hippocrepis emerus (L.) Lassen subsp.emeroides (Boiss. et Spruner) Lassen +, Carex flacca Schreber subsp. serrulata (Biv.) Greuter 1.2; Rel. n. 8: Juniperus communis L. subsp. communis 1.2, Fragaria vesca L. +, Cruciata glabra (L.) Ehrend. +, Lonicera etrusca Santi 1.2, Oryzopsis virescens (Trin.) Beck +; Rel. n. 9: Orobanche hederae Duby +, Abies cephalonica Loudon +.2.

Tab. 6. Rel. n. 1: Euonymus europaeus L. +, Ligustrum vulgare L. +, Arum italicum Miller +; Rel. n. 2: Euonymus europaeus L. +, Geum urbanum L. +, Digitalis micrantha Roth +; Rel. n. 3: Asparagus acutifolius L. 1.2, Juniperus communis L. subsp. communis 1.1; Rel. n. 4: Asparagus acutifolius L. 1.2, Rubia peregrina L. +.2, Cytisophyllum sessilifolium (L.) O. Lang. 1.2, Rubus ulmifolius Schott +; Rel. n. 8: Rubia peregrina L. +; Rel. n. 11: Ligustrum vulgare L. +.

Appendix II: Localities and dates of relevès

Tab. 1. Rel. n. 1: Northern part of the SCI area, above locality Capo di Rio (28.09.2011).

Tab. 2. Rel. n. 1: Macchia delle Tassinete, upper part of the slope, along the main trail near the bend and the landslide (25.08.2010); rel. n. 2: Macchia delle Tassinete, upper part of the slope, along the main trail near the bend and the landslide (27.08.2010).

Tab. 3. Rel.. n. 1, 2, 3: Macchia delle Tassinete, right slope of Fosso delle Scalette (02.08.2002); rel. n. 4: Macchia delle Tassinete, right slope of Fosso delle Scalette (26.06.2012); rel. n. 5: Macchia delle Tassinete, right slope of Fosso delle Scalette, area between the main path and the lower path (26.06.2012); rel. n. 6, 7: Macchia delle Tassinete, right slope of Fosso delle Scalette (26.06.2012); rel. n. 8: Macchia delle Tassinete, right slope of Fosso delle Scalette (01.08.2002); rel. n. 9: Macchia delle Tassinete, right slope of Fosso delle Scalette, area between the main path and the lower path (26.06.2012).

Tab. 4. Rel. n. 1, 2, 3: Macchia delle Tassinete, small gorge under Villa Tassinete (25.08.2010); rel.n.4: Macchia delle Tassinete, slope close to Villa Tassinete (30.09.2011); rel.n.5: Macchia delle Tassinete: small gorge under Villa Tassinete (28.09.2011); rel.n.6: Macchia delle Tassinete: small gorge under Villa Tassinete (30.09.2011); rel.n.7: Macchia delle Tassinete, slope close to Villa Tassinete (30.09.2011); rel.n.8: Macchia delle Tassinete: small gorge under Villa Tassinete (28.09.2011); rel.n.9: Macchia delle Tassinete, slope close to Villa Tassinete (28.09.2011).

Tab. 5. Rel. n. 1, 2: Fosso delle Scalette, gorge on the right side above footpath for Capo di Rio (25.08.2010).

Tab. 6 Rel. n. 1, 2, 3, 4: Upper part of Internone (28.09.2011); rel. n. 5, 6, 7: Upper part of Internone (21.10.2012); rel. n. 8, 10: Flat area on the top of Tassinete (28.09.2011); rel. n. 9: On the top of Tassinete (28.09.2011); rel. n. 11: Slope on the upper area Tassinete (30.09.2011); rel. n. 12: Upper part of Internone next to Tassinete (21.10.2012).