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Guide to the Excursion of the "Fédération Internationale de Phytosociologie" to the Natural Parks of Conero, Gran Sasso and Monti della Laga, and Circeo

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Excursion to the Circeo National Park

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Fig. 1 - View of the Circeo National Park

Introduction

The excursion includes visits to the land units of the subcoastal plains, the coastal dunes, and to those of the limestone promontory that are in the territory of the Circeo National Park (Fig. 1).
This concerns vegetation of important biogeographical value as it is situated in an area of mixing between the West Mediterranean biocore and that of south-eastern Europe, and with central European intrusions on the more meso-hygrophitic aspects.
Moreover, as the coastal and subcoastal areas of the Tyrrhenian coast have been greatly modified by the activities of man, the plant communities of the Circeo National Park have acquired a high value as a record of the mature and intermediate stages of the vegetation series that have by now disappeared or become fragmented in other coastal territories.
The Park flora numbers 1,200 species, more than a third of the entire flora of Lazio which includes a little more than 3,000 species (Anzalone *et al.*, 1997). Moreover, it has also been noted that around sixty of these species are rare or very rare in Lazio, and 17 of them are only found in Circeo.
Among the rare species, there are a few of particular biogeographical interest, rare in Lazio or in the rest of the Italian territory, that can be found on the Promontory (*Asplenium marinum, Centaurea cineraria* subsp. *circae* (Fig. 2), *Leontodon intermedius, Asphodelus ramosus, Crocus longiflorus*), on the coastal dune (*Malcolmia littorea*), and in the forest (*Vicia disperma, Gratiola officinalis, Succisa pratensis*) (Lattanzi, 1998).

The National Park

The Circeo National Park (Fig. 3) is located in eastern Lazio and covers an area of 8,484 hectares (20,964 acres; 33 square miles). Despite its limited extent, it is characterised by a notable variety of species and communities, and for the presence of very diverse morphological, lithological and phytoclimatic environments (Pezzotta, 1998). On a small scale, there are already five main zones: the coastal dune, the retrodunal de-

Fig. 2 - *Centaurea cineraria* subsp. *circae* (Somm.) Cela Renzoni et Viegi

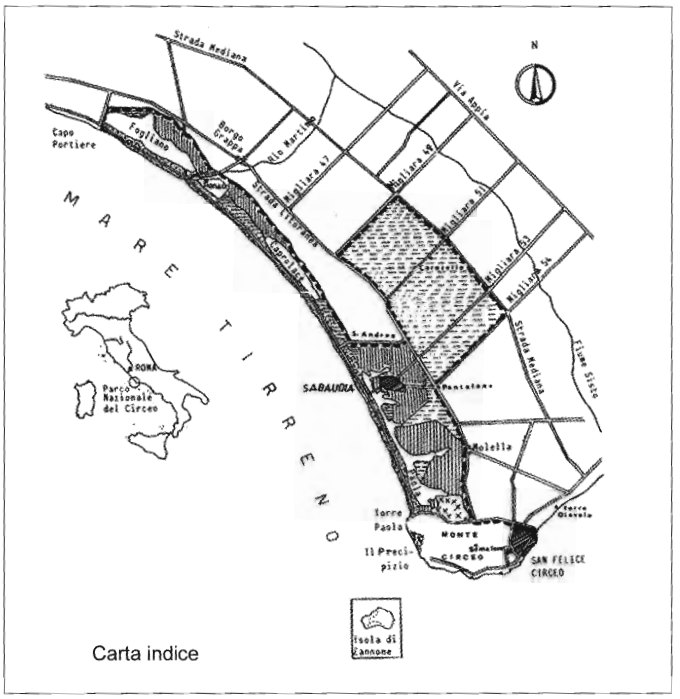

Fig. 3 - Circeo National Park (tyrrhenian district of southern Lazio): geographical location and administrative boundaries

pression with the coastal salt lakes and their adjacent humid zones, the continental dune covered in part by the "demaniale" (state-owned) Forest (the remaining strips of the ancient forest of Terracina), the limestone promontory (Circeo Mountain), and Zannone Island (vulcanic substrate).

In 1934, when it was initially founded, the Park consisted of only the coastal dune, the demaniale Forest, Paola Lake, the promontory, a few cultivated and uncultivated areas, and the residences of Sabaudia and San Felice Circeo, and it covered an area of around 7,500 hectares (18,718 acres; 29 square miles) (Padula, 1985). In 1975, the coastal lakes of Fogliano, Monaci and Caprolace were included, and, in 1979, Zannone Island, the only Ponziano archipelago island to be included.

Phytoclimate

The definition of the phytoclimate of Circeo has been based on the multivariate analysis of the thermopluviometric parameters (monthly averages of the highest and lowest temperatures and the rainfall, in the period from 1955 to 1995) of eight meteorological stations (at Fondi, Terracina, Gaeta, the city of Latina, Borgo Faiti, Torre Olevola, Sabaudia, and Ponza) distributed in or near the Park (Fig. 4). An analysis of the raw data with the SYN-TAX programme (Podani, 1993), followed by calculations of the climatic indexes of Rivas-Martinez (1987, 1996) has allowed the recognition in the Park of a single climatic region (Mediterranean region), and three bioclimatic belts: sub-humid meso-Mediterranean, sub-humid thermo-Mediterranean, and dry thermo/meso-Mediterranean (Fig. 5).

The first of these, the sub-humid meso-Mediterranean, is found in the major part of the Park territory (the dune line, the retrodune, the ancient dune and the northern aspects of the promontory), and is characterised by a mean annual precipitation of around 800-900 mm, by three months of summer drought, and by minimum average temperatures below 5°C in the coldest months. The sub-humid thermo-Mediterranean belt, characterised by milder winters and by a dryer climate (when considering both the annual and summer precipitation), is limited to the southern aspects of the limestone promontory. Finally, the dry thermo/meso-Mediterranean belt is found on Zannone Island and, as compared to the meso-Mediterranean, is characterised by a lower annual precipitation, a lower average maximum temperature and higher minimum temperatures.

With respect to the bioclimatic classification of Lazio

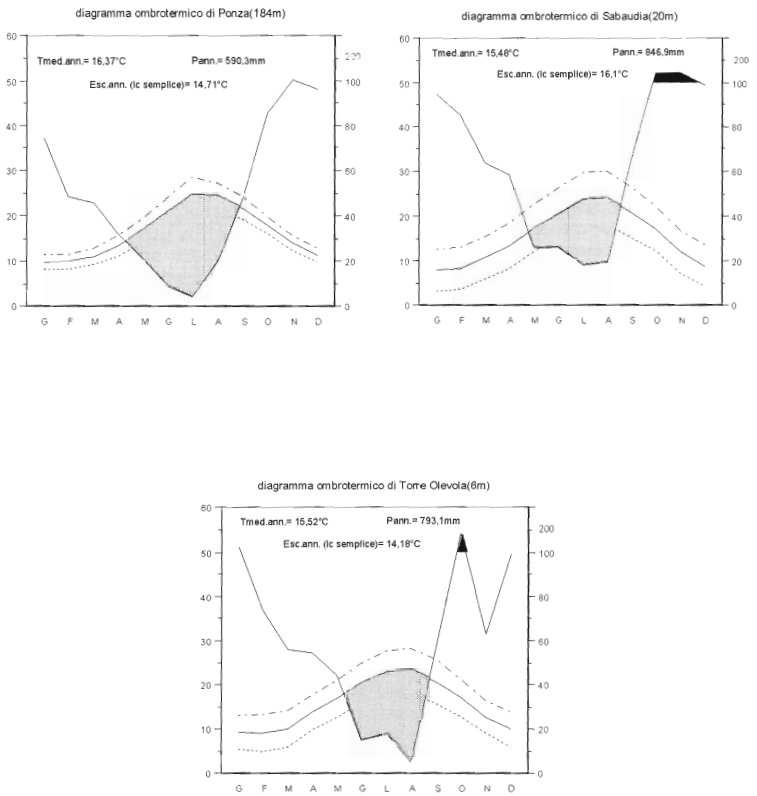

Fig. 4 - Umbro-thermic diagrams concerning four thermo-pluviometric stations occurring within the Circeo area

at a scale of 1:250,000 with the data of the thirty years of 1955 to 1985 (Blasi, 1994), a general decrease in the precipitation has been noted, which has resulted in certain modifications with regard to the ombrotypes and to the extension of the thermo-Mediterranean phytoclimatic class.

Lithology and geomorphology

The recent dune, the ancient dune, and the retrodunal depression are characterised by Quaternary soils, that can be recognised as part of the sedimentary facies typical of the transition between the marine and continental environments.

The coastal dune, from the Holocene age, follows parallel to the line of the coast for about 30 kilometres (19 miles), and is formed of grey and yellow sands. Before the reclamation of the 1930s, it was the major obstacle to the efflux to the sea of the waters from the Lepini and Ausoni Mountains, and the main cause of the marshy character of the Pontina plain. Along the crest, the dune has a panoramic road, interrupted for some years between Monaci Lake (Foce Vecchia) and Capralace Lake (Strada della Lavorazione).

The word "ancient dune" applies instead to a vast continental dune, formed at the start of the Pliocene and mainly made up of particularly red, silt-sand layers, loose at the top and more-or-less compacted in the lower layers. This structure has a certain heterogeneity, arising mainly from the different ages of the origins and formation of its parts, and can include various compositional and textural vulcanic products, arising from the Albano volcanic activity.

Finally, the retrodunal depression is made up of ancient lagoon deposits (mud-marsh clay sediments) and of organic soils that extent between the coastal line and the ancient dune, more or less at sea level. This humid area, included in the Circeo National Park in 1975 (with the exception of Paola Lake, which was already included in the original founding act of 1934) and recognised as a Ramsar area of international interest, includes (from north to south) the coastal lakes of Fogliano, Monaci, Caprolace and Paola, which are the remains of a vast

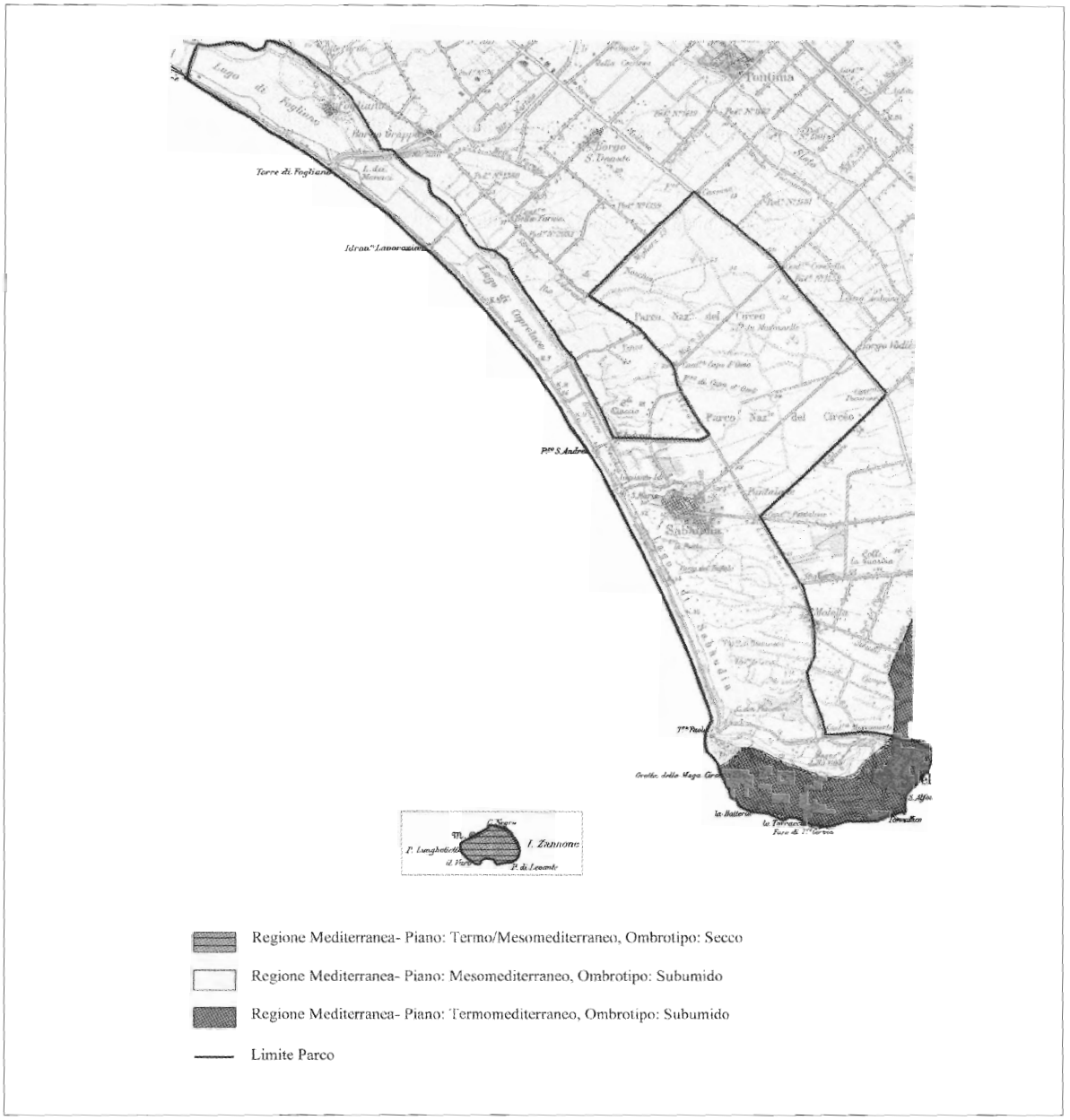

Fig. 5 - Phytoclimatic map of the Circeo National Park

Quaternary lagoon facing the Pontina plain. Paola Lake has a natural sea outlet; its western coast is straight, while its eastern coast is indented with inlets, called "bracci" (arms), that penetrate into the continental dune. The other coastal lakes have artificial connections to the sea and have straightened edges that are in part cemented; these are used for the professional fishermen and for the semi-intensive fisheries. Between the lakes, there are areas that are periodically flooded because of the difficulties in removal of the rain water and the overflowing of the channels and the salt lakes. Among these, the extensive grassland of the "Pantani dell' Inferno" (Hell Marshland) is of particular importance, situated south of Caprolace Lake and set up as a Natural Reserve exclusive for animals. This area, of around 40 hectares (100 acres), is generally flooded in the periods from October to November and May to June.

Mount Circeo is an outcrop (541 metres) surrounded for almost two thirds of its circumference by the sea. In the periods of the infringements of the sea linked to the glacial and post-glacial crises of the Quaternary, it formed an island in the open sea. From a geological

point of view, it represents a part of the limestone Apennine, made up of three tectonic planes of solid limestone overlapping each other and lying on flysch limestone-marl.

The southern aspect, known as "Quarto Caldo" (the hot quarter), is mainly made up of dolomitic limestone of the inferior Lias. The slope is uniform and around 50%, excluding the very steep walls of the south-west aspect (called "il precipizio"; the precipice) and, more in general, the strip in direct contact with the sea, characterised by a sudden increase in slope.

The northern aspect, known as the "Quarto Freddo" (the cold quarter), is mainly made up of marl limestone and white flint limestone of medium Lias that is often covered with cones and layers of limestone detritus. Excluding the limestone cliffs of the summit (with a slope of more than 100%), this aspect has lighter slopes in comparison to the Quarto Caldo and ends with footslopes characterised by a substrate showing a significantly sandy composition.

Zannone Island, positioned about 15 sea miles to the south of Circeo, was included in the Park in 1979. It extends over about 100 hectares (250 acres), is characterised by high cliff coasts, is more-or-less regular on three sides, and culminates in Monte Pellegrino (Pilgrim Mountain; 194 metres). The metamorphic and sedimentary substratum is largely covered by volcanic rock, produced by the acid vulcanic activity of Roccamonfina.

Systems and land facets of the landscape

Over the last few years, the theme of the hierarchy classification of the territory has returned to being the object of study and theories, in combination with the growth of the ecology of the landscape and with the growing necessity to describe and map the ecosystem for planning and conservation aims (Zonneveld, 1994, 1995; Bailey, 1996; Rowe, 1996). The vegetation can contribute in a significant manner to the hierarchy classification of the territory, especially if it is analysed according to the principles of the Synphytosociology and of the Landscape Ecology (Géhu & Rivas-Martinez, 1981; Rivas-Martinez, 1982; Géhu, 1986; Blasi, 1995; Biondi, 1996). In this context, Blasi *et al.* (2000) have recently defined a methodology for the typing and mapping of the land units, based on an integration of the bioclimatic, lithological, geomorphological and vegetation information.

For a systematic classification, it is best to take into consideration those ecological factors that determine the environmental mosaic and that therefore become particularly relevant to the chosen scale of observation (Klijn & Udo de Haes, 1994).

Following these indications, the proposal of Blasi *et alii* (2000) defines a hierarchical classification system based on five levels that, proceeding from small-scale analyses to analyses progressively in more detail allow the identification of several land units (regions, systems, land facets and so on).

The regions are defined on the basis of the macroclimate. Indeed, on a small scale, the climate represents the most influential factor in the geomorphological processes and the distribution of the soil and vegetation types (Walter, 1984).

The systems of the landscape are defined mainly taking into account the geomorphology and the climate types (in terms of the ombrotype and thermotype).

The land units correspond to parts of the territory in which it is possible to recognise a single type of potential natural vegetation or, in the case of lack of zonality, a single phytotopographical sequence. Besides a vegetation series, which remains the key validating criteria, these land units are defined by specific geomorphological and edaphic characteristics.

The land units therefore come from a methodology that gives weight to homogeneity both at a physical and a biological level.

The land elements are correlated to the single stages that make up the vegetation series of the land unit to which they belong.

It is possible to see how this scheme can be perfectly integratable with the syndynamical analyses of the vegetation: in particular, with the levels of association and series *(sigmetum)* on the scale of greater detail, and with the *geosigmeta* at the level of the land facets (geomorphological and climatic types characterised by more vegetation series). This systematic integration of the phytosociology within a holistic classification of the territory represents an original and very useful contribution for the individuation of the land units and of their potential uses (Blasi & Carranza, 1998; Blasi *et al.* 2000).

As described in the preceding paragraphs, from the phytoclimatic point of view, the Park occupies three different classes within the Mediterranean region, the sub-humid meso-Mediterranean, the sub-humid thermo-Mediterranean, and the dry thermo/meso-Mediterranean phytoclimates. Regarding instead the lithomorphology, it is possible to identify beyond the mainly vulcanic Zannone Island, a carbonatic promontory and a coastal plain, subdividable from the coast towards the inlands

into the following subclasses: the beach and the recent dune, the plain with ancient dune deposits, and the plain with fluvial-lacustrine sediments.

Altogether, on the basis of the phytoclimatic, lithological and geomorphological characters, the Park territory forms the following structures: 1 climatic region, 3 lithological systems (vulcanic, carbonatic, and of the loose deposits) and 12 land facets, according to the following scheme:

Mediterranean region

1. CARBONATIC SYSTEM
Land facets:

1.1 Northern slopes of the promontory under sub-humid meso-Mediterranean climate
1.2 North-eastern slope of the promontory, characterised by calcareous debris on flysch substrate; sub-humid thermo-Mediterranean climate
1.3 Southern slopes of the promontory under sub-humid thermo-Mediterranean climate
1.4 Piedmont of the north-eastern slope of the island of Zannone, dry thermo-Mediterranean climate
1.5 Cliffs and rocks by the sea under sub-humid thermo/meso-Mediterranean climate

2. SYSTEM OF LOOSE FLUVIAL-LACUSTRINE, MARSH AND MARINE DEPOSITS
Land facets:

2.1 Beach and recent coastal dunes under sub-humid meso/thermo-Mediterranean climate
2.2 Coastal lakes under sub-humid meso-Mediterranean climate
2.3 Retrodunal depressions with clay deposits, under sub-humid meso-Mediterranean climate
2.4 Gentle undulations of the ancient dune under sub-humid meso-Mediterranean climate

3 *VOLCANIC SYSTEM (ISLAND OF ZANNONE)*
Land facets:

3.1 Steep northern slopes under dry thermo-Mediterranean climate
3.2 Gentle southern slope under dry thermo-Mediterranean climate
3.3 Cliffs and rocks by the sea under dry thermo-Mediterranean climate

Excursion in the lowland forest (22 September, 2002)

Fig. 6 - The lowland forest of Circeo National Park

The woods of the Italian plains have in great part been destroyed by human activities and are now found only in a few locations. In particular, few areas along the Tyrrhenian coast of central Italy other than those of the Circeo National Park (Fig. 6), which give testimony to the mesophitic and hygrophitic forests that made up these environments before the last radical land reclamation was realised (Beguinot, 1935; Almagià, 1976; Padula, 1985; Stanisci *et al.*, 1996, 1998, 2002).

Botanical studies of the lowland forest of Circeo Park have been carried out by numerous authors (Anzalone *et al.*, 1997; Avena *et al.*, 1982; Beguinot, 1934-36; Blasi, 1984; Blasi & Spada, 1984; Padula, 1985), who have given prominence mainly to the floristic and physionomic characteristics. Recently, a further investigation has been published regarding the syntaxonomy and syndynamics of these communities, that has individuated new associations and subassociations (Blasi *et al.*, 2002).

The plain area of the Park spreads over a series of gently undulating dunes of the late-Pliestocene period, within which different areas can be distinguished by their edaphic features (Dowgiallo & Bottini, 1998) and vegetation types.

In the south-eastern areas that stretch from the promontory to Caprolace Lake, the predominant soils are sandy soils with little water-retention capacity, situated on reddened quartz sand lacking vulcanic minerals. In this environment there are *Quercus suber* and *Q. frainetto* oak woods, and, in the higher areas, evergreen cork and ilex oak woods.

In the north-western areas, that include the major part of the demaniale forests, the "ancient dune" is made up of würmian sands in which is mixed pyroclastic materials that arise from the activity of Laziale Volcano. The soils are considerably more evolved and leached with respect to those nearer the promontory (Selva Piana) and they provide a habitat for *Quercus frainetto* and *Carpinus betulus* forest. The morphology is gently undulating, with heights oscillating between 10-12 metres and 34 metres, and in the depressions there are more marked signs of lixiviation processes, with a B horizon rich in silt and having a notable water-retention capacity (pseudogley). On these soils, submerged for some months of the year, there are the hygrophylic *Quercus robur* and *Fraxinus oxycarpa* woods.

1st and 2nd Stops

The deciduous oak wood series of *Quercus frainetto* and *Q. cerris* (*Mespilo germanicae-Quercetum frainetto arbutetosum unedonis*) (Fig. 7)

The oak wood on the plains is the forest that covers the largest areas within the territory of the Circeo Na-

tional Park, and is a part of the land facet of the slightly undulating morphology of the ancient dune, with a sub-humid meso-Mediterranean phytoclimatic type.

MESPILO GERMANICAE-QUERCETUM FRAINETTO Biondi, Gigante, Pignattelli & Venanzoni 2001
ARBUTETOSUM UNEDONIS Blasi, Stanisci, Filesi, Milanese, Perinelli & Riggio 2002 in press (Tab. 1)

The mature stage of the series is made up of a multistratified wood with a dominant tree layer composed of *Quercus frainetto* and *Q. cerris* (average coverage 85 %, average height 20 metres) and a dominated layer of *Fraxinus ornus, Carpinus betulus* and *Acer campestre* (average coverage 60%, average height 12 metres).

In the shrub layer (average coverage 30%) there are *Crataegus monogyna, Mespilus germanica, Prunus spinosa, Euonymus europaeus,* and *Arbutus unedo.*

The herbaceous and vine layers (average coverage 50%) are instead mainly made up of *Cyclamen hederifolium, Hedera helix, Asparagus acutifolius, Ruscus aculeatus, Pteridium aquilinum, Brachypodium sylvaticum, Daphne laureola,* and *Viola alba* ssp. *dehnhardtii.*

This community corresponds to the association *Mespilo germanicae-Quercetum frainetto*, that includes the mesophytic woods with *Quercus frainetto* and *Carpinus betulus* of the plains and lower hills of Lazio (Biondi *et al.*, 2001). In the Circeo National Park, the undergrowth can be distinguished from that typical of the association by the presence of many elements of *Quercetalia ilicis*, which allows the individuation of a subassociation that has been called *arbutetosum unedonis*, with differential species *Arbutus unedus, Cyclamen hederifolium, Asparagus acutifolius, Allium triquetrum* (Blasi *et al.*, 2002). At the higher hierarchical level, this syntaxon is part of the class *Quercо-Fagetea*, of the order *Quercetalia pubescenti-petraeae* and of the alliance *Lonicero-Quercion pubescentis* (Blasi *et al.*, in preparation).

These woods are now remnants of great documentational value, as they have had drastic modifications in their extent and in their floristic-structural composition following the land reclamation that was carried out in the first half of the last century.

In proximity to the pools, the *Quercus frainetto* wood becomes enriched with some mesophytic species, such as *Quercus robur, Tilia cordata* and *Populus canescens* that make up the subassociation *Mespilo germanicae-Quercetum frainetto quercetosum roboris* (Biondi *et al.*, 2001; Blasi *et al.*, 2002).

Rel. 1. *Mespilo germanicae-Quercetum frainetto arbutetosum unedonis* Blasi, Stanisci, Filesi, Milanese, Perinelli, Riggio 2002 in press

Mespilo germanicae-Quercetum frainetto	
Carpinus betulus L.	2
Mespilus germanica L.	+
arbutetosum unedonis	
Cyclamen hederifolium Aiton	2
Asparagus acutifolius L.	+
Arbutus unedo L.	+
Lonicero etruscae-Quercion pubescentis	
Quercus frainetto Ten.	3
Teucrium siculum Rafin.	+
Quercetalia pubescenti-petreae	
Fraxinus ornus L.	3
Quercus cerris L.	2
Viola alba Besser	+
Sorbus torminalis (L.) Crantz	+
Querco-Fagetea	
Hedera helix L.	3
Rubus ulmifolius Schott	+
Crataegus monogyna Jacq	+
Luzula forsteri DC	+
Brachypodium sylvaticum Beauv	1
Euonymus europaeus L.	+
Melica uniflora Retz.	+
Lathyrus venetus (Miller) Wohlf*	+
Euphorbia amygdaloides L.*	+
Sorbus domestica L.	1
Species from Quercetea ilicis	
Ruscus aculeatus L.	+
Rubia peregrina L.	+
Rosa sempervirens L.	+
Smilax aspera L.	+
Erica arborea L.	+
Quercus ilex L.	2
Carex olbiensis Jordan	+
Other species	
Pteridium aquilinum L.	2
Asphodelus microcarpus Viv	+

Tab. 1 - *Mespilo germanicae-Quercetum frainetto* Biondi, Gigante, Pignattelli, Venanzoni 2001
subass. *arbutetosum unedonis* Blasi, Stanisci, Filesi, Milanese, Perinelli, Riggio 2002 in press
subass. *quercetosum roboris* Biondi, Gigante, Pignattelli, Venanzoni 2001

Releves Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	*19	20	21	19	20	21	22	23	24	25	26	27
Mespilo germanicae-Quercetum frainetto Biondi et al. 2001																														
Carpinus betulus L.	.	3	4	.	+	.	3	2	3	2	2	1	2	2	+	2	.	.	2	4	3	2	1	4	2	3	.	1	2	2
Mespilus germanica L.	+	.	+	1	1	+	1	+	+	+	1	1	+	+	.	1	+	+	+	+	2	.	.	.	.	.	.	.	.	.
Aristolochia rotunda L.	+	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Daphne laureola L. ssp. laureola	.	.	.	.	.	+	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	+
Vicia grandiflora Scop.	.	.	.	+	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
subass. arbutetosum unedonis Blasi, Stanisci, Filesi, Milanese, Perinelli, Riggio 2002 in press																														
Cyclamen hederifolium Aiton	.	.	1	1	+	1	2	+	2	1	1	+	+	+	1	1	1	1	2	+	2	.	.	.	.	.	.	.	.	.
Asparagus acutifolius L.	.	.	.	.	+	.	+	+	.	.	+	+	.	.	+	+	+	+	+	+	.	.	.	.	.	.	+	1	+	.
Allium triquetrum L.	2	+	.	.	.	.	1	.	+	+	+	+	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Arbutus unedo L.	+	.	+	.	.	+	1	.	+	+	.	.	.	.	+	.	+	+	+	.	1	.	.	.	.	.	.	.	.	.
subass. quercetosum roboris Biondi, Gigante, Pignattelli, Venanzoni 2001																														
Quercus robur L.	2	2	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	2	2	3	3	2	2	.	2	3	1
Populus canescens (Aiton) Sm.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	4	3	.	4
Tilia cordata Miller*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	3	3
Lonicero etruscae-Quercion pubescentis Arrigoni & Foggi 1988 ex Arrigoni in Arrigoni, Mazzanti et Ricceri 1990																														
Quercus frainetto Ten.	1	2	3	2	2	2	1	1	+	2	2	2	1	1	4	2	2	3	3	2	4	1	1	.	+	2	2	1	1	.
Teucrium siculum Rafin.	.	+	+	+	+	+	+	.	+	+	+	+	.	.	.	+	+	.	+	.	.	+	.	.	.	.	.	.	.	.
Serratula tinctoria L. ssp. tinctoria	.	.	.	.	+	.	.	.	+	.	+	+	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Quercetalia pubescenti-petreae Klika 1933 corr. Moravec in Beguin et Theurillat 1984																														
Fraxinus ornus L.	2	.	2	4	4	4	3	4	2	3	4	3	3	3	4	3	4	3	3	2	4	3	3	2	2	1	3	3	1	3
Quercus cerris L.	4	3	4	4	3	3	3	4	3	3	4	4	4	4	2	4	4	4	2	3	5	3	2	.	.	.	.	3	2	3
Acer campestre L.	.	.	.	.	.	+	.	.	1	+	+	+	1	1	.	+	.	1	.	.	.	.	.	.	+	.	1	.	.	1
Viola alba Besser	.	1	+	+	+	.	.	.	.	.	.	.	+	+	+	+	.	.	+	+	.	+	+	.	.	.	.	.	1	.
Sorbus torminalis (L.) Crantz	.	+	.	.	.	.	+	.	.	+	.	.	.	.	+	+	1	+	+	+	2	+	.	.	.	.	+	+	.	.
Lithospermum purpurocaeruleum L.	.	.	.	.	+	.	.	.	+	+	.	+	.	.	+	+	+	+	.	.	.	.	.	.	+	.	.	.	.	.
Stachys officinalis Trevisan	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Ligustrum vulgare L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1
Pyrus pyraster Burgsd.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	.	.	.	.	.	.	.	.	.
Carpinus orientalis Miller	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.
Crepis leontodontoides All.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Querco roboris-Fagetea sylvaticae Br. Bl. & Vlieger in Vlieger 1937																														
(Fagetalia sylvaticae Pawl. 1928*)																														
Hedera helix L.	+	2	3	4	+	3	1	2	3	4	3	3	3	3	3	3	3	4	3	4	5	2	5	5	5	3	3	4	2	3
Rubus ulmifolius Schott	+	+	+	.	+	+	1	+	+	+	+	+	+	+	+	+	+	+	+	+	1	1	+	+	+	+	2	.	2	1
Crataegus monogyna Jacq	.	.	+	1	+	+	+	+	+	+	+	1	+	+	+	+	+	+	+	+	1	.	+	+	.	.	+	.	+	+
Luzula forsteri DC	+	.	+	+	+	1	+	+	+	1	+	1	+	+	+	+	.	+	+	+	4	+	+	1	1	+	.	.	.	.
Brachypodium sylvaticum Beauv	.	+	+	1	1	+	.	+	+	1	+	1	1	1	+	1	+	1	1	+	3	+	+	+	1	1	.	1	1	+
Euonymus europaeus L.	.	2	.	.	.	+	+	+	.	.	+	1	1	1	1	+	1	+	+	.	.	+	+	+	1	1	.	1	+	.
Melica uniflora Retz.	.	.	+	.	.	+	1	1	+	+	+	1	1	1	.	+	+	.	+	+	.	1	+	1	1	+	1	1	2	2
Malus sylvestris Miller	+	.	+	1	+	+	1	1	+	+	+	2	+	+	+	1	+	1	.	+	.	.	1	.	+	.	.	.	+	+
Ajuga reptans L.	+	+	+	.	.	.	+	.	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Lathyrus venetus (Miller) Wohlf*	.	.	+	+	.	.	.	.	.	+	.	+	1	1	+	+	+	.	+	+	2	.	+	+	1	+	+	.	.	.
Festuca heterophylla Lam.*	.	.	.	+	+	+	+	+	.	.	.	+	.	.	.	.	+	+	.	+	.	+	.	.	+	.	.	.	.	.
Euphorbia amygdaloides L.*	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	+	+	+	.	.	+	.	.
Prunus spinosa L.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Viola reichembachiana Jordan*	.	+	+	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sorbus domestica L.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+	.	1	+	1	+	2	.	.	.	.	.	.	.	.	.
Ranunculus lanuginosus L.*	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Geranium robertianum L.	.	.	.	.	+	.	.	.	.	.	+	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Tamus communis L.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.
Lonicera caprifolium L.	+	+	+	+	1	.	+	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ulmus minor Miller	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.
Viola odorata L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Species from Quercetea ilicis Br.-Bl. ex A. & O. Bolòs 1950																														
Ruscus aculeatus L.	1	.	3	3	3	+	3	4	3	+	3	1	4	4	1	+	1	+	+	+	2	2	1	1	1	+	1	2	3	3
Rubia peregrina L.	+	1	+	.	.	+	+	.	+	+	+	+	+	+	+	+	+	+	+	+	5	.	+	+	+	+	.	+	+	1
Rosa sempervirens L.	.	.	+	+	+	.	.	+	+	.	.	.	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.
Smilax aspera L.	.	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	.	+	+	+	1	.	.	.	.	.	.	.	.	.
Lonicera implexa Aiton	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+	1	+	1	+	+
Erica arborea L.	.	.	.	.	2	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	1	.	.	.	.	.	.	.	.	.
Quercus ilex L.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	+	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.
Cistus salvifolius L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Melica arrecta Kuntze	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cytisus villosus Pourret	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myrtus communis L.	.	.	.	.	+	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex olbiensis Jordan	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Phillyrea angustifolia L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Viburnum tinus L. ssp. tinus	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyclamen repandum Sm.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Osyris alba L.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other species																														
Pteridium aquilinum L.	.	.	+	2	2	1	1	1	1	1	+	1	1	1	+	+	+	+	2	1	4	+	1	+	2	.	2	2	1	3
Asphodelus microcarpus Viv	.	.	.	1	+	.	.	.	.	.	+	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.
Geranium purpureum Vill.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fragaria vesca L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	2	.	.	.	.	.	.	.	.	.
Ornithopus compressus L.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pinus pinea L.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vicia hirsuta (L.) S.F. Gray	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachypodium rupestre (Host) Roem et Schult.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex acetosa L.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dactylis glomerata L.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cruciata laevipes Opiz	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stellaria media (L.) Vill	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carduus pycnocephalus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Teucrium chamaedrys L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.
Sonchus maritimus L. subsp. maritimus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.

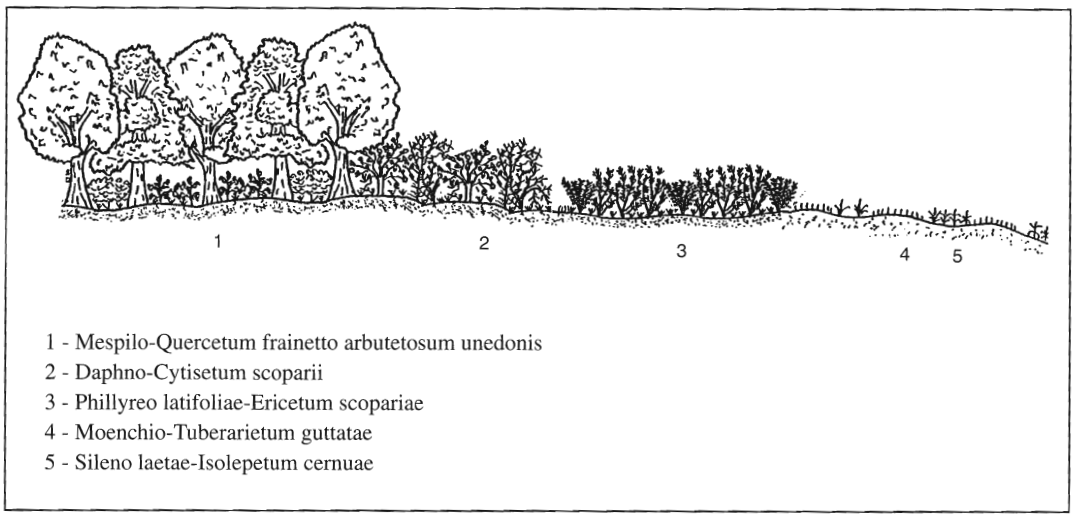

Fig. 7 - *Mespilo germanicae-Querceto frainetto* sigmetum

Serial contacts

DAPHNO GNIDII-CYTISETUM SCOPARII Blasi, Stanisci, Filesi, Milanese, Perinelli, Riggio 2002 in press

In the clearings in the wood or outside the wooded area, there is a shrub covering of *Rubus ulmifolius*, *Cytisus scoparius* and *Prunus spinosa*, rich in vine species such as *Rubia peregrina, Asparagus acutifolius, Hedera helix*, belonging to the suballiance *Pruno-Rubenion ulmifolii* (Arnàiz et Loidi, 1983; Blasi *et al.*, 2002) and to the association *Daphno gnidii-Cytisetum scoparii* (Tab. 2). The characteristic species of the association are: *Daphne gnidium* and *Cytisus scoparius* (Blasi *et al.* 2002).

Rel. 2. *Daphno gnidii-Cytisetum scoparii* Blasi, Stanisci, Filesi, Milanese, Perinelli, Riggio 2002 in press

Daphno gnidii-Cytisetum scoparii	
Cytisus scoparius (L.) Link	2
Daphne gnidium L.	+
Pruno-Rubenion	
Pruno-Rubion ulmifolii	
Rubus ulmifolius Schott	3
Rubia peregrina L.	+
Euonymus europaeus L.	+
Asparagus acutifolius L.	1
Prunetalia spinosae	
Rhamno-Prunetea spinosae	
Prunus spinosa L.	1
Crataegus monogyna Jacq	3
Malus sylvestris Miller	+
Species from Quercetea ilicis	
Ruscus aculeatus L.	1
Arbutus unedo L.	+
Other species	
Brachypodium sylvaticum Beauv	+
Hedera helix L.	4
Fraxinus ornus L.	+
Quercus cerris L.	+
Mespilus germanica L.	3
Daphne laureola L.	+
Fragaria vesca L.	+
Geranium robertianum L.	+

PHILLYREO-ERICETUM SCOPARIAE Blasi, Stanisci, Filesi, Milanese, Perinelli, Riggio 2002 in press

Along the eastern limits of the forest there are large areas of shrubs of *Erica scoparia*, *Myrtus communis* and *Juniperus communis*. These shrub formations are associated with areas that were heavily grazed up to half-way through the last century, and have been described as *Phyllireo latifoliae-Ericetum scopariae* (Tab. 3), included in the alliance *Ericion arboreae* (Blasi *et al.* 2002). The characteristic species are: *Erica scoparia, Juniperus communis* and *Pulicaria odora.*

Rel. 3. *Phillyreo latifoliae-Ericetum scopariae* Blasi, Stanisci, Filesi, Milanese, Perinelli, Riggio 2002 in press

Phyllireo latifoliae-Ericetum scopariae

Tab. 2 - *Daphno gnidii-Cytisetum scoparii* Blasi, Stanisci, Filesi, Milanese, Perinelli, Riggio 2002 in press

Releves Number	1	2*	3	4	5
Daphno gnidii-Cytisetum scoparii Blasi, Stanisci, Filesi, Milanese, Perinelli, Riggio 2002 in press					
Cytisus scoparius (L.) Link	1	2	2	.	2
Daphne gnidium L.	.	+	.	2	2
Pruno-Rubion ulmifolii O. de Bolòs 1954					
Rubus ulmifolius Schott	5	3	4	4	4
Rubia peregrina L.	+	+	2	1	.
Euonymus europaeus L.	.	+	2	+	+
Pruno-Rubenion					
Asparagus acutifolius L.	.	1	1	1	1
Myrtus communis L.	1	.	+	.	+
Smilax aspera L.	.	.	.	.	+
Prunetalia spinosae Tüxen 1952					
Rhamno-Prunetea spinosae Rivas-Goday & Borja ex Tüxen 1962					
Prunus spinosa L.	.	1	+	.	.
Crataegus monogyna Jacq	.	3	.	+	+
Pteridium aquilinum L.	1	.	.	1	.
Acer campestre L.	1	.	.	.	.
Malus sylvestris Miller	1	+	.	.	.
Sorbus torminalis (L.) Crantz	.	.	+	.	.
Species from Quercetea ilicis Br.-Bl. ex A. & O. Bolòs 1950					
Ruscus aculeatus L.	+	1	1	+	+
Arbutus unedo L.	.	+	+	.	.
Erica arborea L.	.	.	.	+	.
Other species					
Brachypodium sylvaticum Beauv	1	+	+	1	.
Hedera helix L.	2	4	4	4	4
Fraxinus ornus L.	+	+	2	2	1
Quercus cerris L.	+	+	1	.	.
Mespilus germanica L.	.	3	2	+	.
Daphne laureola L.	+	+	.	.	+
Aristolochia rotunda L.	+	.	.	.	.
Fragaria vesca L.	+	+	.	.	.
Teucrium siculum Rafin.	+	.	.	+	.
Euphorbia amygdaloides L.	.	.	.	1	.
Geranium robertianum L.	.	+	.	.	.

Tab. 3 - Phillyreo latifoliae-Ericetum scopariae Blasi, Stanisci, Filesi, Milanese, Perinelli, Riggio 2002 in press

Releves Number	1	2	3	4	5*	6	7	8	9
Phyllireo latifoliae-Ericetum scopariae Blasi, Stanisci, Filesi, Milanese, Perinelli & Riggio 2002 in press									
Erica scoparia L.	5	3	5	5	5	4	5	5	5
Pulicaria odora (L.) Rchb	1	+	.	.	+	+	+	+	+
Juniperus communis L.	+	1	+	2	1	1	1	.	.
Ericion arboreae Rivas-Martínez ex Rivas-Martínez, Costa & Izco 1986) Rivas-Martínez 1987									
Pistacio lentisci-Rhamnetalia alaterni Rivas-Martinez 1975									
Myrtus communis L.	2	2	2	1	2	1	1	1	2
Daphne gnidium L.	.	.	+	.	.	.	.	.	.
Melica arrecta Kuntze	.	+	.	.	+	.	+	+	+
Rhamnus alaternus L.	.	.	.	2	.	.	.	.	.
Arbutus unedo L.	.	.	+	.	1	1	.	.	.
Quercetea ilicis Br.-Bl. ex A. & O. Bolòs 1950									
Phillyrea latifolia L.	2	3	2	+	1	2	+	+	1
Ruscus aculeatus L.	+	.	.	+	+	+	1	1	+
Rubia peregrina L.	+	.	.	.	.	+	+	.	.
Smilax aspera L.	+	.	.	.	+	+	.	.	.
Asparagus acutifolius L.	.	.	.	.	+	+	+	.	.
Carex hallerana Asso	.	.	.	.	.	.	+	+	+
Lonicera implexa Aiton	.	.	.	.	+	.	.	.	.
Species from Rhamno-Prunetea spinosae Rivas-Goday & Borja ex Tüxen 1962									
Hedera helix L.	.	.	.	.	+	+	1	+	+
Rubus ulmifolius Schott	.	.	+	.	.	+	+	.	.
Cytisus scoparius (L.) Link	.	.	.	.	.	+	.	.	+
Crataegus monogyna Jacq	+	.	.	.	.	.	.	.	.
Malus sylvestris Miller	+	.	.	.	.	.	+	.	1
Sorbus torminalis (L.) Crantz	.	.	.	.	.	.	1	.	+
Tamus communis L.	.	.	.	.	+	.	+	.	.
Lonicera caprifolium L.	.	.	.	.	.	.	+	.	.
Prunus spinosa L.	.	.	.	.	.	.	.	.	+
Pyrus pyraster Burgsd	.	.	.	1	.	.	.	.	.
Species from Quercetalia pubescenti-petreae Klika 1933 corr. Moravec in Bèguin & Theurillat 1984									
Querco roboris-Fagetea sylvaticae Br. Bl. & Vlieger in Vlieger 1937									
Quercus frainetto Ten.	.	+	.	.	1	1	2	2	1
Quercus cerris L.	.	+	1	2	.	.	.	1	+
Fraxinus ornus L.	1	1	.	+	+	+	1	2	+
Stachys officinalis Trevisan	.	1	.	+	.	.	1	.	.
Brachypodium sylvaticum Beauv	+	.	.	.	.	.	.	.	.
Other species									
Carex flacca Schrank	1	+	.	.	.	.	.	.	.
Cistus salvifolius L.	.	.	.	.	.	.	.	.	.
Oenanthe pimpinelloides L.	1	+	.	.	.	.	.	.	.
Melica uniflora Retz.	.	.	1	+	.	.	.	.	.

Erica scoparia L.	5
Pulicaria odora (L.) Rchb	+
Juniperus communis L.	1
Ericion arboreae, Pistacio lentisci-Rhamnetalia alaterni	
Myrtus communis L.	2
Melica arrecta Kuntze	+
Arbutus unedo L.	1
Quercetea ilicis	
Phillyrea latifolia L.	1
Ruscus aculeatus L.	+
Smilax aspera L.	+
Asparagus acutifolius L.	+
Lonicera implexa Aiton	+
Species from Rhamno-Prunetea spinosae	
Hedera helix L.	+
Tamus communis L.	+
Species from Quercetalia pubescenti-petreae	
Querco roboris-Fagetea sylvaticae	
Quercus frainetto Ten.	1
Fraxinus ornus L.	+

MOENCHIO-TUBERARIETUM GUTTATAE Lucchese & Pignatti 1987

The herbaceous clearings inside the forest are dominated by a terophytic and hemicryptophytic complex. Among the most frequent species are *Cynosurus polybracteatus, Moenchia mantica, Briza maxima, Coleostephus myconis,* and *Anthoxantum odoratum*. The association within which these herbaceous clearings are found is *Moenchio-Tuberarietum guttatae* (*Helianthemion guttatae*) (Tab. 4) described for the coastal and subcoastal areas of Lazio by Lucchese and Pignatti (1987).

SILENO LAETAE-ISOLEPETUM CERNUAE Blasi, Stanisci, Filesi, Milanese, Perinelli & Riggio 2002 in press

Between the grasses of *Moenchio-Tuberarietum guttatae*, there are nanoterophytic communities of *Juncus bufonius, J. capitatus* and *J. pygmeus*, rich in rare species like *Isoetes velata, Lythrum borysthenicum, Apium crassipes* and *Silene laeta* (Lattanzi, 1998). These temporary pool community with a spring cycle have been included in the association *Sileno laetae-Isolepetum cernuae* (Tab. 5), of the alliance *Cicendio-Solenopsion laurentiae* (Blasi *et al.* 2002; Brullo et Minissale, 1998). The characteristic species are: *Isolepis cernua, Silene laeta, Isoetis histrix,* and *I. velata.*

Catenal contacts

In the proximity of the pools, *Mespilo germanicae-Quercetum frainetto arbutetosum unedonis* is found in a catenal contact with strips of the meso-hygrophilic woods of *Quercus robur* and *Fraxinus angustifolia subsp. oxycarpa*, included in the association *Veronico scutellatae-Quercetum roboris (Populion albae)* (Stanisci *et al.*, 1998). In the transitional area between the two wood types, *Quercus robur* and *Tilia cordata* differentiate the subassociation *quercetosum roboris* of the *Mespilo germanicae-Quercetum frainetto*, which is also spread along the fall lines and the drainage channels within the forest.

In the higher parts of the ancient dune there is instead a catenal contact with *Quercus frainetto* and *Q. suber* wood of *Quercetum frainetto-suberis*.

VERONICO SCUTELLATAE-QUERCETUM ROBORIS Stanisci, Presti & Blasi 1998

The more mature stage of the vegetation series of the humid depressions of the ancient dune is made up of *Quercus robur* and *Fraxinus oxycarpa* forest (Stanisci *et al.*, 1998): *Veronico scutellatae-Quercetum roboris* (Tab. 6). In the past, when the level of the water table was higher and there were not any channels that drained the rain water, the flooding of the inter-dunal depressions in the forest plain was frequent (forming the pools). These days, these humid environments have been restored with the damming of some of the drainage channels that convey the rain waters into them, and they form stagnant waters in periods of heavy rain (Stanisci *et al.*, 1996).

The soils are leached, with a sandy matrix, rich in organic matter and with an increasing content of clay within the first two metres of depth; the pH changes from acidic in the superficial layers to near-neutral in those more deep.

Inside these pools there are tree formations with a prevalence of *Quercus robur* and *Fraxinus oxycarpa*; the shrub layer is poor, while the herbaceous one is well represented by *Veronica scutellata, Galium elongatum, Agrostis stolonifera*, and *Mentha aquatica*.

The woods of the pools are characterised by the infiltration of boreal species that have wide distribution in the northern emisphere.

Tab. 4 - Moenchio-Tuberarietum guttatae Lucchese & Pignatti 1987

Releves Number	1	2	3	4
Moenchio-Tuberarietum guttatae Lucchese & Pignatti 1987				
Cynosurus polybracteatus Poiret	1	3	.	3
Moenchia mantica (L.) Bartl	.	.	.	2
Lotus angustissimus L.	2	1	+	1
Aira elegans Willd	.	.	2	.
Trifolium ligusticum Balbis	.	+	.	.
Heliantemion guttati Br.-Bl. in Br.-Bl. Molinier & Wagner 1940				
Ornithopus pinnatus (Miller) Druce	+	.	+	1
Galium divaricatum Lam	1	.	.	.
Oglifa gallica Chrtk et Holub	+	1	.	.
Parentucellia viscosa (L.) Caruel	+	.	.	.
Heliantemetalia guttati Br.-Bl. in Br.-Bl. Molinier & Wagner 1940				
Coleostephus myconis (L.) Cass	4	2	+	1
Briza maxima L.	1	1	+	2
Tuberaria guttata (L.) Fourr	1	.	3	4
Rumex bucephalophorus L.	.	+	1	2
Tolpis umbellata Bertol	.	1	+	.
Trifolium glomeratum L.	.	.	+	.
Trifolium strictum L.	.	.	.	+
Avena barbata Potter	.	.	.	+
Vulpia ciliata (Danth) Link	.	.	+	.
Heliantemetea guttati (Br.Bl. in Br.-Bl., Roussine & Nègre 1952) Rivas-Goday & Rivas-Martínez 1963				
Gaudinia fragilis (L.) Beauv	1	1	2	.
Briza minor L.	+	+	+	.
Hypochoeris radicata L.	1	+	2	1
Vulpia membranacea (L.) Link	1	1	+	2
Anagallis arvensis L.	2	1	+	2
Ornithopus compressus L.	.	.	1	+
Trifolium campestre Schreber	.	+	1	.
Cerastium ligusticum Viv.	.	.	1	.
Linum strictum L.	.	1	.	.
Trifolium lappaceum L.	.	1	.	.
Species from Brachypodietalia phoenicoidis Br.-Bl. ex Mol. 1935 Festuco-Brometea Br.-Bl. et Tx.1943				
Carex flacca Schrank	2	1	.	.
Linum bienne Miller	1	1	.	.
Centaurium erythraea RAFN	+	+	.	.
Trifolium angustifolium L.	.	+	.	.
Species from Isoeto-Nanojuncetea Br.-Bl. & Tüxen ex Westhoff, Dijk & Passchier 1946				
Juncus capitatus Weigl	1	+	.	2
Silene laeta (Aiton) Godron	2	2	.	.
Laurentia gasparrini (Tineo) Strobl	+	.	.	.
Isoetes histrix Bory	.	1	.	1
Other species				
Anthoxantum odoratum L.	3	2	+	2
Plantago lanceolata L.	+	1	1	.
Oenanthe pimpinelloides L.	+	1	.	.
Holcus lanatus L.	+	.	+	.
Centaurea iacea sot angustifolia L.	+	+	.	.
Bromus hordeaceus L.	.	+	.	+
Inula viscosa Aiton	.	+	.	.
Asphodelus microcarpus Viv	1	.	.	+
Euphorbia falcata L.	2	1	.	.
Ranunculus flabellatus Desf	.	.	.	+
Daucus carota L.	.	.	+	.
Agrostis stolonifera L.	.	.	.	+
Kickxia commutata (Bernh) Fritsch	.	.	+	.
Prunella laciniata L.	.	.	.	.
Reichardia picroides (L.) Roth	.	.	.	1
Rumex angiocarpus Murb	.	.	.	+
Serapias lingua L.	.	.	.	+

Tab. 5 - *Sileno laetae-Isolepetum cernuae* Blasi, Stanisci, Filesi, Milanese, Perinelli & Riggio 2002 in press

Releves Number	1	2	3*
Sileno laetae-Isolepetum cernua Blasi, Stanisci, Filesi, Milanese, Perinelli & Riggio 2002 in press			
Isolepis cernua (Vahl) R et S	1	2	+
Silene laeta (Aiton) Godron	.	.	+
Isoetes histrix Boby	1	+	+
Cicendio-Solenopsion laurentiae Brullo & Minissale 1998			
Anagallis parviflora Hoffmgg et Link	+	+	+
Cicendia filiformis Delarbre	1	+	1
Radiola linoides Roth	2	2	.
Illecebrum verticillatum L.	2	2	2
Hypericum australe Ten	.	+	.
Isoetetalia Br.-Bl. 1936			
Lotus angustissimus L.	+	2	1
Laurentia gasparrini (Tineo) Strobl	.	1	+
Myosotis sicula Guss	.	1	.
Lythrum borystenicum (Schrank) Litv	.	2	+
Isoeto-Nanojuncetea Br.-Bl. & Tüxen ex Westhoff, Dijk & Passchier 1946			
Juncus bufonius L.	2	3	1
Juncus capitatus Weigl	1	.	.
Mentha pulegium L.	.	.	1
Juncus pygmeus Richard	2	2	3
Juncus tenageja Ehrh	2	.	+
Species from Helianthemetea guttatae (Br.Bl. in Br.-Bl., Roussine & Nègre 1952) Rivas-Goday & Rivas-Martínez 1963			
Euphorbia exigua L.	.	+	+
Ornithopus pinnatus (Miller) Druce	.	+	.
Other species			
Linum bienne Miller	.	+	+
Ranunculus ophioglossifolius Vill	.	2	1
Juncus gr. articulatus	.	+	+
Lythrum portula (L) D.A. Webb	.	.	+
Euphorbia cuneifolia Guss	+	.	.

Fig. 8 - *Veronico scutellatae-Quercetum roboris*

Rel. 4. *Veronico scutellatae-Quercetum roboris* Stanisci, Presti & Blasi 1998

Veronico scutellatae-Quercetum roboris (Fig. 8)	
Quercus robur	4
Veronica scutellata	2
Oenanthe aquatica	+
Glyceria fluitans	2
Populion albae, Populetalia albae	
Fraxinus oxycarpa	1
Ulmus minor	1
Querco-Fagetea	
Quercus cerris	1
Pyrus pyraster	1
Succisa pratensis	+
Other species	
Iris pseudacorus	1
Galium elongatum	2
Agrostis stolonifera	3
Mentha aquatica	2
Lycopus europaeus subsp. europaeus	+
Alisma plantago-aquatica	1
Populus tremula	2
Juncus effusus	1
Rumex conglomeratus	+

3rd and 4th Stops - Excursion in the coastal dune

The Park coastal dune extends for 30 kilometres (19 miles), comprising the area from Capo Portiere (to the north-west) to Torre Paola (to the south-east), following the base of the limestone promontory; it is outlined to the west by the Tyrrhenian sea and to the east by four retrodunal lakes: Fogliano Lake, Monaci Lake, Caprolace Lake and Paola Lake. The last of these is the only one that has maintained its natural morphology, while the others have been altered by man. The lakes are joined to the sea via artificial channels, thus rendering the waters partially salty (Fig. 9-10).

The average width of the dune line is 250 metres, with an average height of 12 metres that shows a minimum of 10 metres at Capo Portiere and a maximum of 27 metres near Torre Paola. A coastal road runs along the whole crest of the dune, recently breaking up only in the last stretch of the Park territory.

The substratum is made up of grey and yellow Holocene sand, mainly of limestone (20% $CaCO_3$) with abundant quantities of quartz (Padula, 1985). The coastal dune line is often very constricted between the water's edge and the retrodunal lakes, often with very steep front slopes which are suffering from erosion.

Studies of the coastal dune vegetation of the Mediterranean basin have shown the presence of floristically and structurally differentiated communities that form an almost regular sequence in the areas less disturbed by man, starting from the water's edge and proceeding towards the retrodunal area (Arrigoni *et al.*, 1985; Biondi 1999; Garcia Novo, 1977; Géhu, Biondi 1994; Géhu *et al.*, 1984).

For the coastal dune of Circeo National Park the optimal phytotopographical sequence is outlined below, even if it is found intact only rarely, and more often than not the vegetation zonation is interrupted or fragmented (Acosta *et al.*, 1998, 2000, 2001).

Starting from the beach, there is (Fig. 11):

- Annual psammophylous vegetation of *Cakile maritima*, that grows behind the tidemark, *(Salsolo-Cakiletum aegyptiacae)*, mainly substituted by the annual community of *Ononis variegata*: *Silene coloratae-Ononidetum variegatae*;
- Perennial herbaceous psammophylous vegetation of *Elytrigia juncea* on the embryonal dunes: *Echinophoro spinosae-Elytrigetum juncei*;
- Perennial herbaceous psammophylous vegetation of *Ammophila australis* on the mobile dunes *Echinophoro spinosae-Ammophiletum australis*;
- Chamaephytic community with *Crucianella maritima*

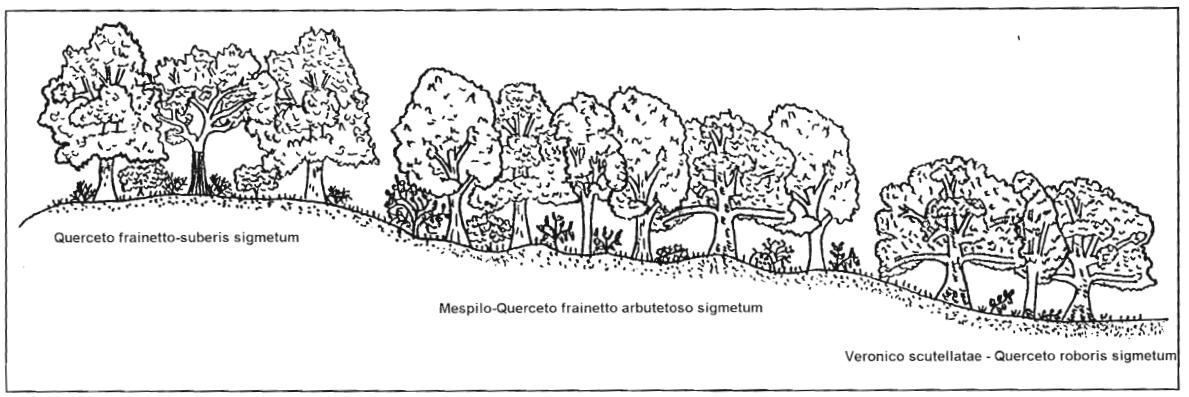

Fig. 9 - Ancient dune (Pleisocene) vegetation profile

Fig. 10 - Recent dune (Holocene)

in the first interdunal spaces: *Pycnocomo rutifoliae-Crucianelletum maritimae*;

• *Juniperus oxycedrus* ssp. *macrocarpa* pioneer maquis on the first more structured and fixed dunes;

• Terophyte grasses of *Vulpia (sp.pl).* and *Silene colorata*, forming a mosaic pattern with the shrubs and the perennial vegetation of the sea-side slopes of fixed dunes: *Sileno coloratae-Vulpietum membranaceae*;

• *Juniperus oxycedrus* ssp. *macrocarpa* maquis at further distances from the sea, on the more internal fixed dunes: *Asparago acutifolii-Juniperetum macrocarpae*;

• *Juniperus phoenicea* maquis in the first retrodunal slope: *Phillyreo angustifoliae-Juniperetum phoeniceae*

• *Quercus ilex* woods in the more internal retrodunal area: *Viburno tini - Quercetum ilicis*

• *Quercus ilex* and *Q.robur* woods connecting with the humid retrodunal depressions: *Viburno tini - Quercetum ilicis quercetosum roboris* (Rivas-Martinez *et al.*, 1975, 1985, 1995).

In the retrodunal areas, in catenal contact with *Quercus ilex* and *Q.robur* woods (close to Paola Lake), there are fragments of woods of *Fraxinus oxycarpa* and *Frangula alnus* with *Cladium mariscus* in the undergrowth (Stanisci *et al.*, 1998), assigned to *Cladio marisci-Fraxinetum oxycarpae* subass. *caricetosum otrubae* (Tab. 6). This community occupies environments with hydromorphic soils, with a superficial, slightly salty water table.

Tab. 6 - Igrofilous woods

Releves Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fragment of Hyperico hircini-Alnetum glutinosae Gafta & Pedrotti 1996,																	
Osmundo regalis-Alnion glutinosae (Br.-Bl., Siiva & Rozeira 1956) Dierschke et Riv-Mart. 1975																	
Alnus glutinosa	3	4	5	3	4	.	.	.	.	.	.	.	.	.	.	.	.
Osmunda regalis	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladio marisci-Fraxinetum oxycarpae Piccoli, Gerdol & Ferrari 1983																	
Frangula alnus	.	.	.	.	1	2	1	2	1	2	1	.	1	+	1	.	.
Cladium mariscus	.	.	.	.	.	3	1	.	.	.	1	.	.	.	.	.	.
Samolus valerandi	.	.	.	.	.	+	+	1	.	.	.	.	.	.	.	.	.
Potentilla reptans	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
Carex distans	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
caricetosum otrubae Stanisci, Presti, Blasi 1998																	
Lythrum salicaria	.	+	.	.	.	1	1	1	+	1	+	1	1	.	.	.	.
Lysimachia vulgaris	.	.	.	.	.	+	1	1	1	.	.	.	.	.	.	.	.
Carex otrubae	.	.	.	.	.	1	+	.	3	2	.	.	.	.	.	.	.
Veronico scutellatae-Quercetum roboris Stanisci, Presti & Blasi 1998																	
Quercus robur	.	.	.	2	.	1	2	1	+	.	.	4	2	.	3	4	2
Veronica scutellata	.	.	.	.	.	.	.	.	.	.	.	2	1	1	1	.	.
Juncus conglomeratus	.	.	.	.	.	.	.	.	.	.	.	.	2	1	1	+	.
Oenanthe aquatica	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.
Glyceria fluitans	.	.	.	.	.	.	.	.	.	.	.	2	1	2	.	.	.
Populion albae Br.Bl. ex Tchou 1948, Populetalia albae Br.Bl. ex Tchou 1948																	
Fraxinus oxycarpa	.	.	.	.	.	4	4	+	4	5	3	1	+	1	2	1	5
Vitis vinifera	.	.	+	.	.	+	1	+	.	1	.	.	.	.	.	.	.
Carex remota	+	1	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Salix cinerea	.	.	.	.	.	1	1	2	.	.	.	.	.	.	.	.	.
Salix alba	2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ulmus minor	+	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
Populus nigra	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Althaea officinalis	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Rumex sanguineus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Querco-Fagetea Br. Bl. & Vlieger in Vlieger 1937																	
Hedera helix	+	+	+	2	3	.	1	1	.	+	2	.	.	.	.	1	.
Rubus ulmifolius	+	1	2	2	.	2	2	1	1	1	2	.	.	.	.	.	.
Euonymus europaeus	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clematis vitalba	.	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Malus sylvestris	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Myosotis caespitosa	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus lanuginosus	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arum italicum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melica arrecta	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Prunus spinosa	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1	.
Brachypodium sylvaticum	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola reichembachiana	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Mycelis muralis	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Carex flacca subsp. serrulata	.	.	.	.	.	1	1	+	.	.	1	.	.	.	.	.	.
Acer campestre	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Holcus lanatus	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	2	.
Quercus cerris	.	.	.	.	.	.	.	.	.	.	.	1	3	2	2	1	.
Pyrus pyraster	.	.	.	.	.	.	.	.	.	.	.	1	1	2	.	1	1
Crataegus monogyna	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Lythrum hyssopifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.
Succisa pratensis	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Mespilus germanica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Quercus frainetto	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Oenanthe pimpinelloides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Other species																	
Carex riparia	4	3	4	+	4	.	.	.	.	.	.	.	.	.	.	.	.
Iris pseudacorus	3	3	2	+	2	.	.	1	2	1	.	1	1	+	.	.	.
Equisetum ramosissimum	+	+	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.
Calystegia sepium	.	.	1	1	2	1	1	+	1	2	.	.	.	.	.	.	.
Eupatorium cannabinum	+	.	+	+	.	.	.	1	.	.	+	.	.	.	.	.	.
Solanum dulcamara	.	+	+	.	2	.	.	.	.	.	.	.	.	.	.	.	.
Galium elongatum	.	.	.	1	1	1	+	+	+	1	.	2	1	4	2	+	1
Agrostis stolonifera	+	.	1	.	.	2	.	.	1	1	.	3	3	1	3	3	.
Sambucus nigra	.	.	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Nerium oleander	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phragmites australis	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Mentha aquatica	+	.	.	.	.	+	+	1	+	.	+	2	2	1	.	2	+
Lycopus europaeus subsp. europaeus	.	+	.	.	.	.	1	+	.	.	.	+	.	.	.	.	.
Thelypteris palustris	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Isolepis cernua	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.
Cirsium craeticum subsp. triumfetti	.	.	.	.	.	.	+	.	.	.	1	.	.	.	.	.	.
Cyperus longus subsp. longus	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.
Scrophularia auricolata	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.
Hypericum tetrapterum	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Juncus articulatus	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Holoschoenus australis	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Juncus subnodulosus	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Lythrum junceum	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Carex elata	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Tamarix gallica	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Festuca arundinacea	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Carex punctata	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Dorycnium rectum	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Juncus acutus	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Pulicaria dysenterica	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Alisma plantago-aquatica	.	.	.	.	.	.	.	.	.	.	.	1	2	1	+	.	.
Populus tremula	.	.	.	.	.	.	.	.	.	.	.	2	1	3	.	.	.
Lysimachia nummularia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1
Juncus effusus	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
Calamagrostis epigejos	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Rumex conglomeratus	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Polygonum hydropiper	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Lonicera japonica	.	+	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Ficus carica	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Smilax aspera	.	.	.	+	.	.	1	+	.	.	1	.	.	.	.	.	.
Asparagus acutifolius	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Pteridium aquilinum	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubus hirtus	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
Stellaria media	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Quercus ilex	.	.	.	.	.	.	1	.	.	.	+	.	.	.	.	.	.
Rubia peregrina	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Phillyrea latifolia	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Laurus nobilis	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Lonicera etrusca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Senecio erraticus subsp. erraticus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.

Rel. 5. *Echinophoro spinosae-Elytrigetum junceae* Géhu 1988 corr. Géhu 1996

Elymus farctus	3
Echinophora spinosa	2
Othanthus maritimus	1
Eryngium maritimum	1
Cyperus kalli	1
Medicago marina	+
Pancratium maritimum	+

Rel.6. *Echinophoro spinosae-Ammophiletum australis* (Br.-Bl. 1921) Géhu, Rivas Martínez & R.Tx. in Géhu 1975

Ammophila littoralis	3
Medicago marina	2
Anthemis maritima	2
Lotus cytisoides	2
Calystegia soldanella	1
Sporobolus pungens	1
Pancratium maritimum	+

Rel.7. *Pycnocomo rutifolii - Crucianelletum maritimae* Géhu, Biondi, Géhu -Frank & Taffetani, 1987

Pycnocomum rutifolium (= Scabiosa rutifolia)	3
Anthemis maritima	2
Centaurea spherocephala	2
Lotus cytisoides	2
Scabiosa atropurpurea ssp. maritima	1
Daucus gingidium	1
Crucianella maritima	1
Dianthus sylvestris subsp. longicaulis	+
Euphorbia terracina	+
Reichardia picroides	+
Cyperus kalli	+

Rel.8. *Asparago-Juniperetum macrocarpae* (R.& R.Molinier 1955) O.Bòlos 1962

Juniperus oxycedrus ssp. macrocarpa	4
Asparagus acutifolius	+
Juniperus phoenicea	1

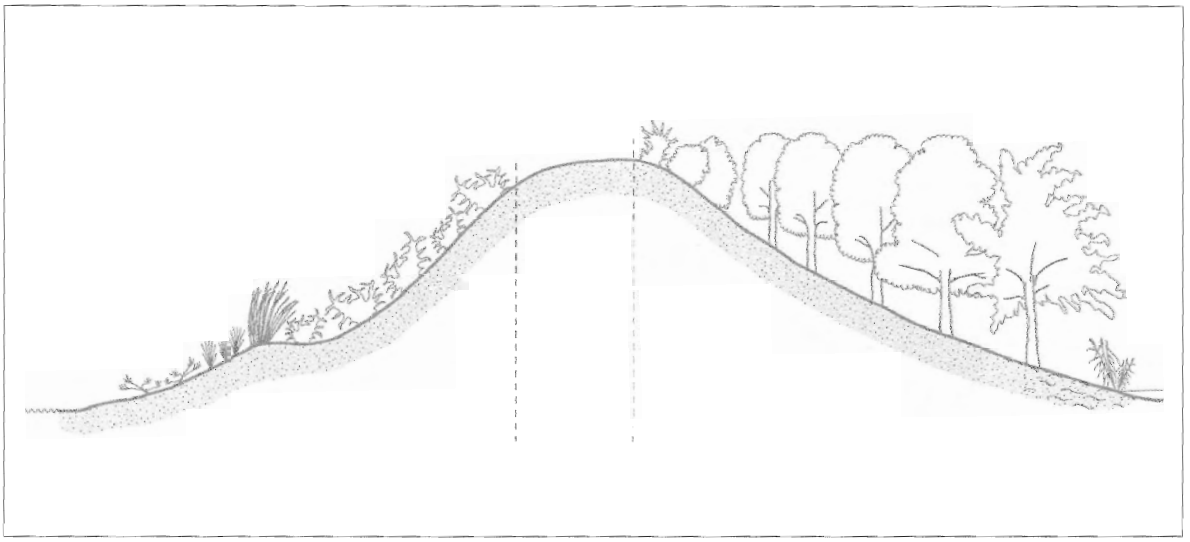

Fig. 11 - Recent dune vegetation profile

Phyllirea angustifolia	2
Rhamnus alaternus	3
Rubia peregrina	2
Pistacia lentiscus	2
Daphne gnidium	+
Clematis flammula	+
Prasium majus	1
Smilax aspera	2
Lonicera implexa	1

Rel.9. *Sileno coloratae-Vulpietum membranaceae* (Pignatti 1953) Géhu & Scoppola 1984

Vulpia membranacea	3
Cutandia maritima	2
Trifolium scabrum	2
Silene canescens	
(=S. colorata subsp. canescens)	1
Cerastium semidecandrum	1
Bromus rigidus	1
Plantago coronopus	1
Ononis variegata	+
Pseudorlaya pumila	+
Medicago littoralis	+
Phleum arenarium	+

Rel. 10. *Cladio marisci-Fraxinetum oxycarpae caricetosum otrubae* Stanisci, Presti, Blasi 1998

Cladio marisci-Fraxinetum oxycarpae	
Frangula alnus	2
Cladium mariscus	3
Samolus valerandi	+
Carex distans	1
caricetosum otrubae	
Lythrum salicaria	1
Lysimachia vulgaris	+
Carex otrubae	1
Populion albae, Populetalia albae	
Fraxinus oxycarpa	4
Vitis vinifera	+
Salix cinerea	1
Querco-Fagetea	
Rubus ulmifolius	2
Carex flacca subsp. serrulata	1
Acer campestre	+
Quercus robur	1
Other species	
Calystegia sepium	1
Galium elongatum	1
Agrostis stolonifera	2
Mentha aquatica	+
Juncus articulatus	+
Phillyrea latifolia	+

Excursion in the Promontory of Circeo (23 September 2002)

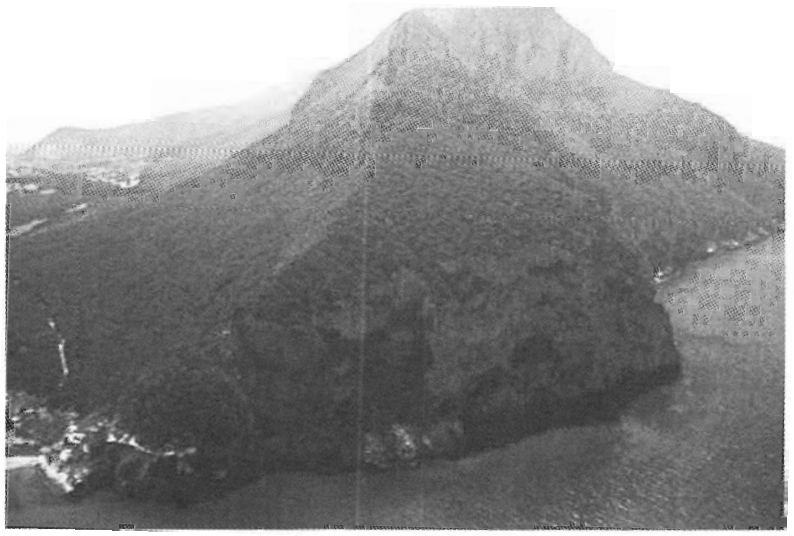

Fig. 12 - Circeo promontory

The floristic and community richness that can be found in the Circeo Promontory (Fig. 12) area arises from the complex interactions between a number of physical factors, particularly the contact with the sea, the geomorphological variability, the notable heights reached (541 metres), the bioclimatic diversity between the two aspects (thermo-Mediterranean thermotype of the Quarto Caldo and the meso-Mediterranean of the Quarto Freddo: Blasi, 1994), and the paleogeographical circumstances (until the ancient Quarternary the promontory was an island). Moreover, and also of importance, other considerations include the influence of the various man activities that have occurred over the course of the centuries, which have provoked a general structural alteration of the plant cover and of the soil features , but has also primed interesting secondary dynamic processes. The substratum is dolomite limestone but it has a notable variability of soils that prevalently correlate with the geomorphology and the disturbances.

Many authors have shown interest in the flora and vegetation of the Park, and among the most recent studies regarding the area under consideration, for the flora, the work of Anzalone *et al.* (1997) should be remembered, and for diverse aspects of the vegetation: Blasi and Spada (1984), Padula (1985), Bartolo *et al.* (1989), Lucchese & Pignatti (1990), Filesi *et al.* (1996), Blasi *et al.* (1997), Di Pietro *et al.* (2002 in press).

Considering the Quarto Freddo, the forest cover is almost continuous, with the exception of breaks corresponding to the paths, the rocky areas, the ancient coal mines (as well as the piedmont olive trees), and in consequence the syndinamical indications are mainly relative to the catenal contacts among forest types.

All the woody communities that will be described, even if they are well characterised structurally and floristically, are anyway still a good distance from the potential vegetation type. The periodic rejuvenation of the vegetation series of the higher sections, cause by the rocks and detritus falling from the crest, is part of the continuing dynamics of these types of morphology. However, in the lower sections, the tree cover is without a doubt of rather recent constitution. It probably originates from the closure of the pastures with sparse *Quercus pubescens* and *Q. suber*, that are similar to those still present today in the Ausoni-Aurunci territory. This has also been confirmed by the aerial photography of the early 1950s and by the examples of *Quercus pubescens* and *Q. suber* with great trunk diameters, low heights and spread branches, that have become included in the footslope forest of today.

On the southern aspects, the agricultural use, pastoral activities, coppicing, recent holiday settlements, and, above all, repeated fires, have caused both a drastic reduction in the forest cover and in the processes of soil evolution.

In particular, the plant communities of the southern aspect (Quarto Caldo) are very different from the floristic and structural point of view: cliff vegetation (coastal and non-coastal), garrigues, terophytic grasslands, formations of *Ampelodesmos mauritanicus*, maquis, and evergreen woods.

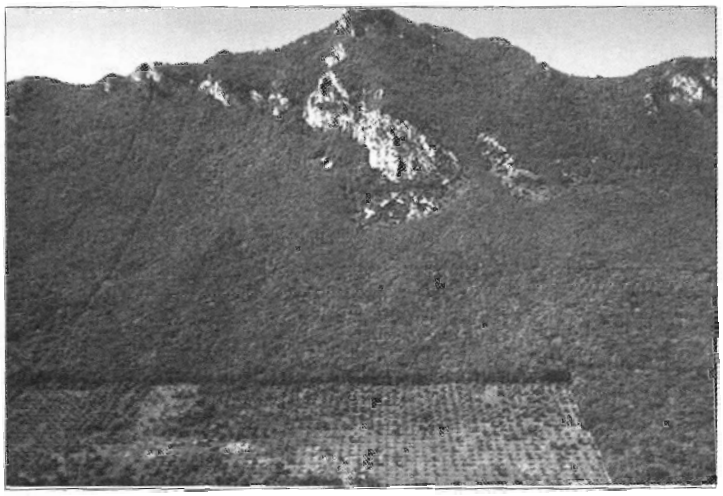

Fig. 13 - Northern slope of Circeo promontory covered by *Quercus ilex* woodlands (*Orno-Quercetum ilicis ostryetosum*)

Northern aspects (Quarto Freddo)

The northern aspects of the Promontory (Fig. 13) are almost entirely covered with woods that characterise the diverse areas that can be differentiated on the basis of their morphology and the soils on which they directly depend:
- area connected with the Pliestocene dune (*Quercetum frainetto-suber*is)
- layer of limestone detritus (*Fraxino orni-Quercetum ilicis suberetosum*)
- steep slopes (*Fraxino orni-Quercetum ilicis ostryetosum carpinifoliae*)
- summit area with the *Pistacia terebinthus* variant of *Fraxino orni-Quercetum ilicis*
- valley on the steep slopes *(Asparago acutifolii-Ostryetum carpinifoliae).*

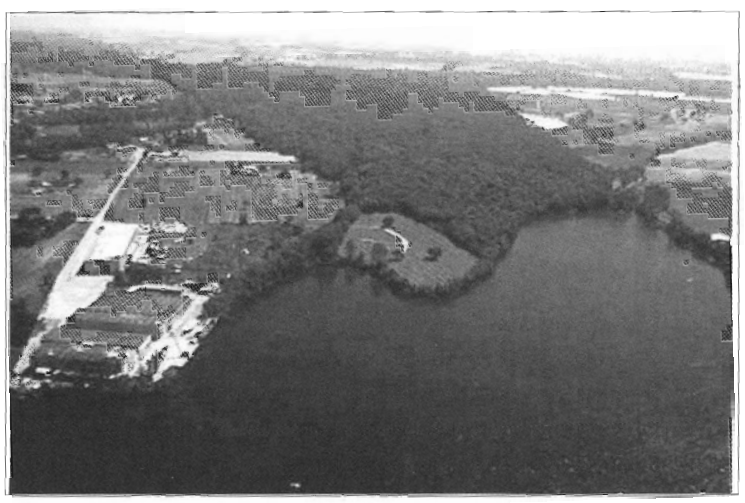

Fig. 14 - *Quercetum frainetto-suberis* woodland (Selva Piana area)

1st Stop - *Quercus frainetto* and *Q. suber* wood

QUERCETUM FRAINETTO-SUBERIS Blasi, Filesi, Fratini, Stanisci 1997

The more mature stage of the vegetation series of the higher areas of the ancient dune, with less compacted sands and regosoil, is made up of *Quercus frainetto* and *Q. suber* wood belonging to the association of *Quercetum frainetto-suberis* (Tab. 7; Fig. 14). That community is well represented in the Selva Piana (Wood Plain) locality, at the foot of the Circeo Promontory. The dominant tree layer, about 15 metres in height (80% coverage), is mainly made up of *Quercus frainetto, Q. suber* and, secondarily, of *Q. ilex* and *Fraxinus ornus*, with a few isolated examples of *Q. crenata*. The dominated tree layer (30% coverage) is made up of *Carpinus orientalis, Erica arborea, Malus sylvestris* and *Phillyrea latifolia*, while the shrub layer (30% coverage) is made

up of *Crataegus monogyna*, *Mespilus germanica* and *Rubus ulmifolius*. There are also numerous vines, such as *Asparagus acutifolius, Smilax aspera, Clematis flammula*, *Hedera helix* and *Rubia peregrina*. In the herbaceous layer (50% coverage) there are *Brachypodium sylvaticum, Ruscus aculeatus, Pteridium aquilinum, Cyclamen hederifolium, Cyclamen repandum* and *Melica arrecta*. In correspondence with slight morphological depressions there are *Quercus robur* and *Laurus nobilis* (cfr. Blasi *et al.*, 1997).

Rel. 11. *Quercetum frainetto-suberis* Blasi, Filesi, Fratini, Stanisci 1997

Quercetum frainetto-suberis	
Quercus suber	2
Clematis flammula	+
Melica arrecta	+
Lonicero etruscae-Quercion pubescentis	
Quercus frainetto	4
Malus sylvestris	1
Mespilus germanica	1
Querco-Fagetea	
Quercetalia pubescenti-petraeae	
Hedera helix	3
Pteridium aquilinum	2
Fraxinus ornus	3
Brachypodium sylvaticum	+
Crataegus monogyna	+
Rubus ulmifolius	+
Luzula forsteri	+
Species from Quercetea ilicis	
Asparagus acutifolius	+
Rubia peregrina	+
Smilax aspera	+
Ruscus aculeatus	1
Erica arborea	+
Phillyrea latifolia	+
Other species	
Cytisus villosus	+

In serial contact with this formation there are mantles of *Cytisus villosus* and *Erica arborea* that can be included in *Citiso villosi- Ericetum arboreae* (Zéller, 1959) (Tab. 8). The catenal contacts are represented by *Mespilo germanicae-Quercetum frainetto arbutetosum unedonis* and by *Fraxino orni-Quercetum ilicis*.

Rel. 12. *Cytiso villosi - Ericetum arboreae* Zéller 1959 (coll. pref.)

Cytiso villosi-Ericetum arboreae	
Cytisus villosus	3
Erica arborea	3
Ericion arboreae	
Cistus salvifolius	1
Arbutus unedo	1
Pistacio lentisci-Rhamnetalia alaterni	
Quercetea ilicis	
Rubia peregrina	+
Asparagus acutifolius	+
Pistacia lentiscus	1
Daphne gnidium	+
Phillyrea latifolia	3
Smilax aspera	2
Ampelodesmos mauritanicus	+
Quercus suber	3
Myrtus communis	+
Ruscus aculeatus	+
Other species	
Rubus ulmifolius	+
Cytisus scoparius	+
Quercus frainetto	+

The connecting area with the Pliestocene dune hosts a formation of *Quercus suber, Q. pubescens, Q. frainetto* and *Ostrya carpinifolia* that still maintains many of the species of the undergrowth of *Quercetum frainetto-suberis* and that in our opinion represents an interesting variante with a prevalence of *Quercetalia pubescenti petreae*.

2nd Stop - Ilex and cork wood

FRAXINO ORNI-QUERCETUM ILICIS Horvatic 1958 *SUBERETOSUM* Selvi & Viciani 1998

The mature stage of the vegetation series of the Quarto Freddo piedmont is the ilex and cork wood. Located on the ancient layers of limestone detritus, and therefore on deep soils that are well drained and decalcified by leaching (brunified and lessivated red soils).

In that wood (10-12 metres in height) dominate *Quercus ilex* and *Quercus suber,* and also abundant are *Arbutus unedo, Fraxinus ornus* and *Erica arborea*. The herbaceous layer is particularly poor, with the sporadic

Tab. 7 - *Quercetum frainetto-suberis* Blasi, Filesi, Fratini & Stanisci 1997

Releves Number	1	2	3	4	5	6	7	8	9	10
Quercetum frainetto-suberis Blasi, Filesi, Fratini & Stanisci 1997										
Quercus suber	2	3	2	1	2	3	4	3	2	3
Clematis flammula	+	.	+	+	+	.	+	.	.	1
Melica arrecta	1	.	+	+	.	.	+	.	.	.
Quercus robur variant										
Quercus robur	.	.	.	.	.	.	.	4	1	3
Laurus nobilis	.	.	.	.	.	.	.	.	+	.
Euonymus europaeus	.	.	.	.	.	.	.	.	+	.
Cyclamen hederifolium	.	.	.	.	.	.	.	.	+	.
Lonicero etruscae-Quercion pubescentis Arrigoni & Foggi 1988 ex Arrigoni in Arrigoni, Mazzanti & Ricceri 1990										
Quercus frainetto	5	3	4	5	2	1	3	.	2	.
Malus sylvestris	+	1	1	1	.	.	+	.	2	1
Mespilus germanica	2	1	1	2	.	.	.	2	.	1
Querco-Fagetea Br. Bl. & Vlieger in Vlieger 1937										
Quercetalia pubescenti-petraeae Klika 1933 corr. Moravec in Béguin & Theurillat 1984										
Hedera helix	4	3	3	4	+	3	3	5	4	3
Pteridium aquilinum	3	1	2	3	+	+	.	2	+	.
Fraxinus ornus	3	1	3	2	.	.	+	+	1	.
Brachypodium sylvaticum	+	+	+	1	.	.	+	+	+	+
Crataegus monogyna	1	.	+	1	.	+	+	.	+	+
Rubus ulmifolius	+	.	+	+	.	1	.	2	+	1
Carpinus orientalis	1	1	.	1	.	.	3	.	4	.
Tamus communis	+	.	.	.	.	+	.	.	+	1
Prunus spinosa	.	.	.	.	.	.	.	1	.	1
Luzula forsteri	.	.	+	+	.	.	.	.	.	.
Sorbus domestica	.	.	.	.	+	+	.	.	.	.
Quercus cerris	.	.	.	.	.	3	.	.	.	.
Fraxinus angustifolia ssp. oxycarpa	.	.	.	.	.	.	.	.	.	2
Quercus pubescens s.l.	.	.	.	.	2	.	.	.	.	.
Viola alba ssp. dehnhardtii	.	.	.	.	.	.	.	.	.	1
Buglossoides purpurocaerulea	+	.	.	.	.	.	.	.	.	.
Acer campestre	.	+	.	.	.	.	.	.	.	.
Lathyrus venetus	.	.	.	+	.	.	.	.	.	.
Species from Quercetea ilicis Br.-Bl. ex A. & O. Bolòs 1950										
Asparagus acutifolius	1	+	+	+	+	+	+	+	+	+
Rubia peregrina	+	+	+	+	+	1	+	1	+	.
Smilax aspera	.	1	+	+	1	1	1	+	1	+
Ruscus aculeatus	2	4	1	2	+	.	2	.	3	.
Erica arborea	.	.	+	+	2	2	+	+	.	+
Phillyrea latifolia	.	+	+	.	+	.	1	.	+	+
Quercus ilex	.	.	.	.	3	.	.	1	.	3
Cyclamen repandum	.	.	.	.	+	2	1	.	.	.
Pistacia lentiscus	.	.	.	.	1	.	.	.	.	1
Myrtus communis	+	.	.	.	.	.	.	.	.	+
Rosa sempervirens	.	.	.	.	.	+	.	+	.	.
Phillyrea angustifolia	.	.	.	.	.	1	.	.	.	.
Arbutus unedo	.	.	.	.	+	.	.	.	.	.
Other species										
Allium triquetrum	.	.	.	.	.	.	.	.	.	2
Arum maculatum	.	.	.	.	.	.	.	.	.	1
Cytisus villosus	.	.	+	.	.	.	.	.	.	.
Asplenium onopteris	.	.	.	.	.	.	+	.	.	.
Clematis vitalba	.	.	.	.	.	.	.	+	.	.
Asphodelus microcarpus	.	.	.	.	.	.	.	.	.	+
Brachypodium ramosum	.	.	.	.	.	.	.	.	.	+
Carex flacca ssp. serrulata	.	.	.	.	.	.	.	.	.	+

Tab. 8 - *Cytiso villosi - Ericetum arboreae* Zéller 1959

Releves Number	1	2	3	4
Exposition	_	_	N	NNE
Inclination (°)	0	0	0	10
Altitude (m)	50	30	70	170
Cytiso villosi-Ericetum arboreae Zéller 1959 (coll. pref.)				
Cytisus villosus	3	5	4	4
Erica arborea	3	.	2	.
Ericion arboreae (Rivas-Martínez ex Rivas-Martínez, Costa & Izco 1986) Rivas-Martínez 1987				
Cistus salvifolius	1	+	1	.
Arbutus unedo	1	.	1	3
Pistacio lentisci-Rhamnetalia alaterni Rivas-Martínez 1975				
Quercetea ilicis Br.-Bl. ex A. & O. Bolòs 1950				
Rubia peregrina	+	1	1	1
Asparagus acutifolius	+	.	2	+
Pistacia lentiscus	1	2	.	.
Daphne gnidium	+	+	.	.
Phillyrea latifolia	3	.	.	1
Smilax aspera	2	.	.	1
Ampelodesmos mauritanicus	+	.	.	1
Quercus ilex	.	.	+	1
Quercus suber	3	.	.	.
Myrtus communis	+	.	.	.
Ruscus aculeatus	+	.	.	.
Rhamnus alaternus	.	1	.	.
Asplenium onopteris	.	+	.	.
Rosa sempervirens	.	.	1	.
Other species				
Rubus ulmifolius	+	1	2	.
Fraxinus ornus	.	1	+	+
Cytisus scoparius	+	.	+	.
Quercus frainetto	+	.	.	.
Hedera helix	.	5	.	.
Allium triquetrum	.	+	.	.
Prunus spinosa	.	.	1	.
Crataegus monogyna	.	.	+	.
Brachypodium retusum	.	.	.	2
Quercus pubescens	.	.	.	+
Tamus communis	.	.	.	+
Pulicaria odora	.	.	.	+

presence of *Asplenium onopteris, Cyclamen repandum, Brachypodium retusum, Carex hallerana,* and *C. otrubae.*

The presence of eastern geoelement in this community (*Fraxinus ornus,* the sporadic presence of *Hippocrepis emerus* subsp. *emeroides* and, in contact with the plain, *Carpinus orientalis*) allows their inclusion in *Fraxino orni-Quercetum ilicis suberetosum* (Tab. 9) which was described for the first time in southern Tuscany (Selvi & Viciani, 1999). The most diffuse serial contact is that estabilished with shrubland of *Arbutus unedo* and *Erica arborea* that is thought to be attributed to *Erico-Arbutetum*, association of *Ericion arboreae.*

Rel. 13. *Fraxino orni-Quercetum ilicis suberetosum* Selvi & Viciani 1998

Fraxino orni -Quercetum ilicis	
Fraxinus ornus	2
Hippocrepis emerus subsp. emeroides	+
Fraxino orni -Quercetum ilicis suberetosum	
Quercus suber	2
Quercion, Quercetalia, Quercetea ilicis	
Quercus ilex	4
Pistacia lentiscus	2
Erica arborea	2
Phillyrea latifolia	2
Arbutus unedo	2
Smilax aspera	2
Rubia peregrina	2
Asparagus acutifolius	1
Myrtus communis	1
Ruscus aculeatus	1
Laurus nobilis	+
Rosa sempervirens	+
Viburnum tinus	+
Carex hallerana	+
Ampelodesmos mauritanicus	+
Other species	
Brachypodium retusum	+
Asplenium onopteris	+

3rd Stop - Coastal dune, retrodunal lakes and the plain

FRAXINO ORNI-QUERCETUM ILICIS Horvatic 1958
OSTRYETOSUM CARPINIFOLIAE Trinajstic 1965

Quercus ilex and *Fraxinus ornus* wood with *Ostrya carpinifolia* (formation visible in the section between the 3rd and 4th stops).

The mature stage of the vegetation series of the steep slopes of the Quarto Freddo is the wood with *Quercus ilex*, *Ostrya carpinifolia* and *Fraxinus ornus*. This forest is located on the medium and highly steep slopes of the northern aspects of the Promontory, with local concentrations of coarse limestone detritus. The aspect has the benefit of a sub-humid meso-Mediterranean climate. The soils are part of the category of the brunified red soils.

The wood has a continuous covering and a tree layer of 10-12 metres in height. In the vine layer there are *Smilax aspera* and *Rubia peregrina*, and in the herbaceous one species such as *Allium triquetrum* and *Cyclamen repandum*, *Asplenium onopteris* and *Dryopteris villarii.*

This is an aspect with *Ostrya carpinifolia* that we consider as included in the subassociation *ostryetosum carpinifoliae* (Tab. 10) of the *Fraxino orni-Quercetum ilicis*. This syntaxon takes up the original proposal of Horvatic (1958), which was furtherly corrected by Trinajstic (1965, 1977) and concerns the physionomic and serial autonomy of this woodland type from the typical *Fraxino orni – Quercetum ilicis*. The occurrence of *Ostrya carpinifolia*, however, is not enough to allow a separation at the association level towards the *Ostryo-Quercetum ilicis* which exhibits a higher floristic affinity with the woods of *Quercetalia pubescenti-petraeae*. In fact, expecially in the tyrrhenian central district of the Italian peninsula it generally tends to occupy the submontane bioclimatic belt which is more often characterized by mixed mesophilous deciduous wood (Trinajstic, 1985).

The tall shrubs that form the covering and that alternate with the ilex in large areas that in the past suffered from fires or other forms of disturbance is mainly made up of *Arbutus unedo, Erica arborea* and is referred to *Erico-Arbutetum.* There are interesting catenal contacts with the woody strips of *Ostrya carpinifolia* present in the deep soils of the fall lines.

Tab. 9 - *Fraxino orni-Quercetum ilicis quercetosum suberis* Selvi & Viciani 1999

Releves Number	1	2	3	4	5	6	7	8
Exposition	NW	NNE	NE	_	N	N	N	NW
Inclination (°)	7	20	15	_	25	10	20	10
Altitude (m)	50	215	70	195	50	210	190	180
Fraxino orni-Quercetum ilicis Horvatic (1956) 1958								
Fraxinus ornus	1	2	2	3	3	1	2	2
Hippocrepis emerus ssp. emeroides	1	.	.	.	.	.	.	+
Cyclamen repandum	.	2	+	.	.	.	.	.
Carpinus orientalis	.	1	.	.	.	.	.	.
Tamus communis	.	.	+	.	.	.	.	.
Fraxino orni-Quercetum ilicis quercetosum suberis Selvi & Viciani 1999								
Quercus suber	4	3	3	4	1	2	1	2
Sorbus domestica	.	2	1	1	.	.	2	.
Quercion ilicis Br.-Bl. 1936 em. Rv.-Mart. 1975								
Quercetalia ilicis Br.-Bl. (1931) 1936 em. Rv.-Mart.1975								
Quercus ilex	4	2	2	3	4	3	3	4
Phillyrea latifolia	2	3	+	1	1	2	1	2
Ruscus aculeatus	3	1	3	1	3	1	2	1
Asplenium onopteris	1	1	+	1	+	+	+	+
Viburnum tinus	+	1	3	1	.	.	.	.
Laurus nobilis	.	.	.	.	1	.	.	.
Viola alba ssp. dehnhardtii	.	.	.	.	.	+	.	.
Quercetea ilicis Br.-Bl. 1947								
Smilax aspera	3	2	1	2	2	3	2	2
Rubia peregrina	2	2	+	2	+	1	1	2
Arbutus unedo	+	3	3	3	2	1	2	2
Asparagus acutifolius	+	1	+	1	+	+	1	1
Pistacia lentiscus	1	1	+	3	+	2	.	2
Rosa sempervirens	.	1	+	1	1	+	+	+
Myrtus communis	.	1	+	2	.	.	+	1
Clematis flammula	.	+	.	.	.	+	.	.
Rhamnus alaternus	.	.	.	.	+	+	.	.
Ampelodesmos mauritanicus	.	.	.	.	.	1	.	+
Carex hallerana	.	.	.	.	.	.	.	+
Viburnum tinus	.	.	.	.	.	.	.	+
Laurus nobilis	.	.	.	.	.	.	.	+
Altre specie								
Quercus pubescens	.	3	.	2	+	+	3	.
Rubus hirtus	1	+	+	.	.	1	.	.
Hedera helix	.	.	2	+	1	1	.	.
Ostrya carpinifolia	.	.	+	+	.	.	1	.
Sorbus torminalis	.	3	.	+	.	.	.	.
Erica arborea	.	.	.	.	+	+	.	.
Ulmus minor	.	.	.	.	.	2	1	.
Carex sylvatica	+	.	.	.	.	.	.	.
Quercus cerris	+	.	.	.	.	.	.	.
Crataegus monogyna	.	.	+	.	.	.	.	.
Melica uniflora	.	.	+	.	.	.	.	.
Melica arrecta	.	.	.	+	.	.	.	.
Quercus frainetto	.	.	.	.	+	.	.	.
Brachypodium sylvaticum	.	.	.	.	.	1	.	.
Carex distachya	.	.	.	.	.	+	.	.
Clematis vitalba	.	.	.	.	.	+	.	.
Mespilus germanica	.	.	.	.	.	+	.	.
Erica arborea	.	.	.	.	.	.	.	2
Acer campestre	.	.	.	.	.	.	1	.
Brachypodium retusum	.	.	.	.	.	.	.	+

Tab. 10 - Fraxino *orni-Quercetum ilicis ostryetosum* Trinajstic 1965

Releves Number	1	4	5	6	7	8	9
Exposition	NNE	N	NE	N	N	E	NE
Inclination (°)	35	20	30	35	15	15	30
Altitude (m)	265	280	180	350	180	105	190
Fraxino orni-Quercetum ilicis Horvatic 1958							
Fraxinus ornus	2	4	2	2	1	3	1
Cyclamen repandum	+	2	.	+	.	2	.
Tamus communis	1	.	.	+	.	1	.
Hippocrepis emerus ssp. emeroides	.	.	.	.	.	2	.
Fraxino orni-Quercetum ilicis ostryetosum Trinajstic 1965							
Ostrya carpinifolia	3	2	4	3	3	1	1
Laurus nobilis	.	.	.	2	.	2	.
Dryopteris villarii subsp pallida	.	.	+	.	.	.	.
Acer campestre	.	.	.	.	.	.	1
Quercion ilicis Br.-Bl. ex Molinier 1934							
Quercetalia ilicis Br.-Bl. ex Molinier 1934							
Quercus ilex	4	4	4	4	4	5	4
Asplenium onopteris	+	.	1	+	1	+	+
Phillyrea latifolia	.	1	+	1	2	+	1
Ruscus aculeatus	1	.	.	1	+	3	2
Viburnum tinus	4	.	+	3	.	3	.
Quercetea ilicis Br.-Bl. ex A. & O. Bolòs 1950							
Rubia peregrina	1	2	2	2	1	2	1
Smilax aspera	1	1	2	2	2	1	2
Arbutus unedo	2	2	2	.	1	.	1
Asparagus acutifolius	.	+	1	1	1	+	1
Pistacia lentiscus	.	1	1	.	+	.	1
Ampelodesmos mauritanicus	.	+	+	.	+	.	.
Clematis flammula	.	.	+	.	.	.	+
Rosa sempervirens	.	.	.	.	+	.	+
Myrtus communis	.	.	.	.	+	.	+
Rhamnus alaternus	.	+	.	.	.	.	.
Pistacia terebinthus	.	.	+	.	.	.	.
Chamaerops humilis	.	.	.	.	.	+	.
Species from Querco-Fagetea Br. Bl. & Vlieger in Vlieger 1937							
Quercus pubescens s. l.	+	1	.	.	2	.	3
Sorbus domestica	.	+	+	.	1	.	2
Cercis siliquastrum	.	+	+	.	+	.	1
Sorbus torminalis	.	.	.	.	1	.	.
Ulmus minor	.	.	.	.	+	.	.
Other species							
Hedera helix	.	.	.	+	1	2	.
Polypodium interjectum	.	.	+	+	.	.	.
Erica arborea	.	1	.	.	.	.	.
Brachypodium ramosum	.	.	+	.	.	.	.
Rubus hirtus	.	.	.	.	+	.	.
Arum italicum	.	.	.	.	.	+	.

Rel. 14. *Fraxino orni-Quercetum ilicis ostryetosum* Trinajstic 1965

Fraxino orni -Quercetum ilicis	
Fraxinus ornus	2
Cyclamen repandum	+
Tamus communis	1
Fraxino orni -Quercetum ilicis ostryetosum	
Ostrya carpinifolia	3
Quercion ilicis	
Quercetalia ilicis	
Quercus ilex	4
Asplenium onopteris	+
Ruscus aculeatus	1
Viburnum tinus	4
Quercetea ilicis	
Rubia peregrina	1
Smilax aspera	1
Arbutus unedo	2
Species from Querco-Fagetea	
Quercus pubescens s. l.	+

FRAXINO ORNI-QUERCETUM ILICIS Horvatic 1958 *PISTACIA TEREBINTHUS* variant

The high steepness in the area of the summit rocks of Quarto Freddo means that the plant community cannot benefit fully from the rain water contribution: that is, it favours the settling of the woody vegetation similar to those present on the Quarto Caldo. In this context, with emerging rocks and abundant loose stones, the ilex wood reaches only 6-7 metres in height. Inside this, *Pistacia terebinthus* is very frequent, and sometimes also included is *Cercis siliquastrum*, and, more rarely, *Rhus coriaria.* On the other hand, this formation never reaches very high levels of coverage. In the area of Quarto Freddo occupied by this variant, clearings are frequently found that are generated by accumulations of coarse detritus and that are colonised by *Lunaria rediviva, Legousia speculum-veneris, Ceterach officinarum* and the rare *Anogramma leptophylla*.

ASPARAGO ACUTIFOLII-OSTRYETUM CARPINIFOLIAE Biondi 1982

The deep and fresh soils of the fall lines present a completely different habitat, where the community dominated by *Ostrya carpinifolia* has a continuous covering and a height of about 15 metres. More mesophytic species also differentiate this aspect: *Acer campestre, Lathyrus venetus, Melica uniflora*. Among the more frequent species there are *Asparagus acutifolius, Rosa sempervirens, Rubia peregrina, Smilax aspera* and *Cercis siliquastrum*. The floristic composition and the physionomy of the mixed deciduous forest leads to the attribution of this community to *Asparago acutifolii-Ostryetum carpinifoliae* (Biondi, 1982).

Rel. 15. *Asparago acutifolii-Ostryetum carpinifoliae* Biondi 1982

Asparago acutifolii-Ostryetum carpinifoliae	
Ostrya carpinifolia	4
Asparagus acutifolius	1
Smilax aspera	1
Osrtyo-Carpinion orientalis	
Quercetalia pubescenti-petraeae	
Querco-Fagetea	
Fraxinus ornus	3
Brachypodium sylvaticum	2
Clematis vitalba	1
Quercus pubescens s. l.	1
Cercis siliquastrum	1
Acer campestre	+
Lathyrus venetus	+
Calamintha sylvatica	+
Clinopodium vulgare	+
Hedera helix	+
Malus sylvestris	+
Allium triquetrum	(+)
Species from Quercetea ilicis	
Quercus ilex	2
Rubia peregrina	2
Phillyrea latifolia	1
Asplenium onopteris	2
Ruscus aculeatus	+
Arbutus unedo	1
Rosa sempervirens	+
Melica arrecta	1
Other species	
Rubus ulmifolius	2
Viola alba ssp. dehnhardtii	+

4th Stop - Quarto Caldo

Fig. 15 - *Pistacia terebinthus* variant of *Fraxino orni-Quercetum ilicis* (high areas of Quarto Caldo)

The *Quercus ilex* wood series of Quarto Caldo

The mature stage of the vegetation series of the southern, medium-steep slopes of the Circeo Promontory is the *Quercus ilex* and *Fraxinus ornus* wood: *Fraxino orni-Quercetum ilicis.*

Besides notably reducing the time over which the surface is covered by the evergreen wood (that now can be found only in the highest areas or along some fall lines), the long history of fires that have always characterised the Quarto Caldo area has started a soil erosion process, with decapitation and re-mixing of the horizon, due to which large areas of this aspect are now covered with limestone detritus mixed with red soils of colluvial origins.

FRAXINO ORNI-QUERCETUM ILICIS Horvatic 1958

The residual woods are mainly made up of *Quercus ilex* and, to a lesser extent, of *Fraxinus ornus.* The height of the formation varies on average between 6 and 10 metres and has a shrub layer of between 1 and 2 metres thick, made up of evergreen species as *Phillyrea latifolia, Rhamnus alaternus, Pistacia lentiscus, Rubia peregrina, Asparagus acutifolius, Smilax aspera* and of *Hippocrepis emerus subsp. emeroides*. The herbaceous layer, as is usual in the undergrowth of ilex woods, is rather poor; the most frequent species are *Arisarum vulgare, Brachypodium retusum, Tamus communis* and *Cyclamen repandum.*

The ilex wood has been attributed to the association *Fraxino orni-Quercetum ilicis* (Tab. 11) described by Horvatic in 1958 for the Balcan peninsula, that appears very diffuse on the Italian peninsula on carbonatic lithotypes (Blasi, 1984; Filesi *et al.*, 1996).

Even if it presents a notable coenological uniformity on the whole of the Quarto Caldo aspect, the ilex wood can be differentiated into two variants. One occupies the areas closer to the coast where individuals of *Juniperus phoenicea* are more frequent, mainly corresponding to local rocky outcrops. The other variant (already described for Quarto Freddo) that occupies the summit areas and spreads also onto the northern aspects, is characterised by a particular abundance of *Pistacia terebinthus* and presents a more discontinuous covering.

Rel. 16. *Fraxino orni-Quercetum ilicis* Horvatic 1958

Fraxino orni -Quercetum ilicis	
Quercion ilicis	
Quercetalia ilicis	
Quercus ilex	4
Hippocrepis emerus subsp. emeroides	3
Phillyrea latifolia	1
Lonicera implexa	1
Fraxinus ornus	2

Carex distachya	+
Quercetea ilicis	
Smilax aspera	2
Asparagus acutifolius	+
Rubia peregrina	1
Pistacia lentiscus	1
Rhamnus alaternus	3
Ampelodesmos mauritanicus	1
Prasium majus	+
Osyris alba	+
Clematis flammula	+
Other species	
Erica multiflora	1
Brachypodium retusum	1
Polypodium australe	+
Teucrium flavum	+
Geranium purpureum	+
Mercurialis annua	+

MYRTO-LENTISCETUM (Molinier (1936) 1954 em. Bolos 1962) Rivas-Martínez 1975

The Mediterranean maquis has been attributed to *Myrto-Lentiscetum* (Tab. 12), characterised by *Pistacia lentiscus, Myrtus communis, Phillyrea latifolia, Rhamnus alaternus*, the vines *Rubia peregrina, Prasium majus, Smilax aspera* and the herbaceous species *Arisarum vulgare, Brachypodium retusum* and *Psoralea bituminosa.* That community is strongly linked to the frequent fires in an area (Blasi *et al.* 1996, 1999), with a sub-humid thermo-Mediterranean climate and relatively high precipitation (almost 1000 mm of rain per year).

Ril 17. *Myrto-Lentiscetum* (Molinier (1936) 1954 em. Bolos 1962) Rivas-Martínez 1975

Myrto-Lentiscetum	
Oleo-Ceratonion	
Pistacio-Rhamnetalia alaterni	
Pistacia lentiscus	3
Ampelodesmos mauritanicus	1
Prasium majus	+
Myrtus communis	3
Rhamnus alaternus	1
Quercetea ilicis	
Arisarum vulgare	1
Rubia peregrina	+
Lonicera implexa	1
Phillyrea latifolia	2
Smilax aspera	+
Other species	
Brachypodium retusum	3
Erica multiflora	2
Bituminaria bituminosa	+
Althaea hirsuta	1

ERICO MULTIFLORAE-ROSMARINETUM OFFICINALIS Di Pietro, Filesi & Blasi 2002 in press

This type of low shrubland is found exclusively on the aspect of the Promontory facing south (Quarto Caldo), where it shows its own synecological optimum in the semi-rocky areas that are characterised by steep slopes and, consequently, a light soil covering. In syntaxonomical terms this community type has been described as *Erico-Rosmarinetum* (Di Pietro *et al.*, 2002, in press) and it represents a low secondary garrigue type that has in *Fraxino orni-Quercetum ilicis* the potential vegetation of reference. The *Erico-Rosmarinetum* of Circeo (Tab. 13) shows strong coenological and syndynamic similarities to those of Dalmatia, which, however, along with *Erica multiflora,* show the presence and sometimes the dominance of *Erica manipuliflora*. All of this obviously poses interesting problems of the highest levels of syntaxonomy with particular reference to the classes of *Cisto-Micromerietea* and *Rosmarinetea officinalis* (Rivas-Goday & Rivas-Martínez, 1967; De Dominicis *et al*, 1988; Rivas-Martínez *et al.*, 1991; Brullo *et al.* 1997; Biondi 2000; Rivas-Martínez *et al.*, 2001).

Concerning the physionomy, there is a clear dominance of *Erica multiflora* and *Rosmarinus officinalis.* Other species well represented in the community, and considered differential species of the association by the authors, are *Hippocrepis emerus* subsp. *emeroides, Ampelodesmos mauritanicus* and *Teucrium flavum*. Other species of the Mediterranean shrubs appear often, but never with high values of coverage, such as *Pistacia lentiscus, Rhamnus alaternus,* and *Phillyrea latifolia.*

Ril. 18. *Erico multiflorae-Rosmarinetum officinalis* Di Pietro, Filesi & Blasi 2002 in press

Erico multiflorae-Rosmarinetum officinalis	
Ampelodesmos mauritanicus	2
Teucrium flavum	+

Tab. 11 - *Fraxino orni-Quercetum ilicis* Horvatic 1958

Releves Number	1	2	3	6	7	8	9	10	11
Exposition	SSE	SSW	S	S	S	WSW	SW	NW	SSE
Inclination (°)	10	10	30	35	30	40	30	30	5
Altitude (m)	200	330	210	350	320	140	70	150	100
Fraxino orni-Quercetum ilicis Horvatic 1958									
Quercion ilicis Br.-Bl. ex Molinier 1934									
Quercetalia ilicis Br.-Bl. ex Molinier 1934									
Quercus ilex	4	5	4	5	4	2	4	2	5
Hippocrepis emerus subsp. emeroides	+	.	1	+	3	.	2	2	1
Phillyrea latifolia	2	1	3	1	1	3	.	.	.
Lonicera implexa	+	.	+	.	1	1	1	+	.
Fraxinus ornus	.	1	.	2	2	.	.	.	3
Arbutus unedo	1	2	.	.	.	+	.	.	.
Viburnum tinus	.	.	.	.	.	1	+	.	2
Carex distachya	.	.	.	.	+	.	.	.	.
Ruscus aculeatus	.	.	.	.	.	.	.	.	3
Asplenium onopteris	.	.	.	.	.	.	.	.	+
Quercetea ilicis Br.-Bl. ex A. & O. Bolòs 1950									
Smilax aspera	2	2	2	2	2	2	1	+	1
Asparagus acutifolius	1	1	1	1	+	1	1	+	1
Rubia peregrina	1	1	1	+	1	.	+	+	1
Pistacia lentiscus	1	2	3	1	1	+	1	.	.
Rhamnus alaternus	1	.	.	1	3	1	2	2	1
Arisarum vulgare	1	1	1	.	.	.	+	+	.
Myrtus communis	1	2	3	.	.	.	+	+	.
Ampelodesmos mauritanicus	1	+	.	.	1	.	+	+	.
Prasium majus	+	.	+	+	+	.	.	.	.
Osyris alba	1	.	.	1	+	.	1	.	.
Juniperus phoenicea	1	.	.	.	.	.	1	2	.
Cyclamen repandum	1	1	.	.	.	.	.	.	.
Clematis flammula	.	+	.	.	+	.	.	.	.
Pistacia terebinthus	.	.	.	1	.	+	.	.	.
Euphorbia dendroides	.	.	.	+	.	.	+	.	.
Chamaerops humilis	.	.	.	.	.	.	+	.	2
Laurus nobilis	.	.	.	.	.	.	.	.	2
Other species									
Erica multiflora	+	.	2	.	1	3	2	2	.
Brachypodium retusum	.	+	1	.	1	2	+	1	.
Tamus communis	.	+	.	+	.	+	.	.	.
Prasium majus	.	.	.	.	.	.	1	2	.
Lonicera caprifolium	+	.	.	.	.	.	.	.	.
Carex hallerana	.	+	.	.	.	.	.	.	.
Polypodium australe	.	.	.	.	+	.	.	.	.
Teucrium flavum	.	.	.	.	+	.	.	.	.
Geranium purpureum	.	.	.	.	+	.	.	.	.
Mercurialis annua	.	.	.	.	+	.	.	.	.
Allium triquetrum	.	.	.	.	.	+	.	.	.
Daucus carota	.	.	.	.	.	+	.	.	.
Anthyllis barba-jovis	.	.	.	.	.	+	.	.	.
Cistus creticus subsp. eriocephalus	.	.	.	.	.	.	1	.	.
Daphne sericea	.	.	.	.	.	.	.	+	.
Hedera helix	.	.	.	.	.	.	.	.	2
Sorbus domestica	.	.	.	.	.	.	.	.	1
Quercus pubescens	.	.	.	.	.	.	.	.	+

Tab. 12 - *Myrto-Lentiscetum* (Molinier (1936) 1954 em. Bolos 1962) Rivas-Martínez 1975

Releves Number	1	2	3	4	5	6
Exposition	S	S	S	SSW	WSW	SSW
Inclination (°)	15	20	15	5	5	20
Altitude (m)	80	130	80	95	85	100
Myrto-Lentiscetum (Molinier (1936) 1954 em. Bolos 1962) Rivas-Martínez 1975						
Oleo-Ceratonion Br.-Bl. ex Guinochet & Drouineau 1944						
Pistacio-Rhamnetalia alaterni Rivas-Martinez 1975						
Pistacia lentiscus	3	4	3	1	2	3
Ampelodesmos mauritanicus	1	+	1	2	2	1
Prasium majus	+	2	+	1	1	1
Myrtus communis	3	2	1	3	3	.
Rhamnus alaternus	1	.	.	.	2	.
Euphorbia dendroides	.	.	3	.	3	.
Quercetea ilicis Br.-Bl. ex A. & O. Bolòs 1950						
Arisarum vulgare	1	+	+	1	.	.
Rubia peregrina	+	1	+	+	.	.
Lonicera implexa	1	.	+	1	1	.
Phillyrea latifolia	2	.	2	.	.	1
Smilax aspera	+	.	.	.	+	.
Hippocrepis emerus subsp. emeroides	.	1	.	2	.	.
Melica arrecta	.	.	.	+	.	.
Asparagus acutifolius	.	.	.	.	+	.
Juniperus phoenicea	.	.	.	.	.	2
Other species						
Brachypodium retusum	3	2	2	.	2	2
Erica multiflora	2	1	2	.	+	.
Cistus monspeliensis	.	2	2	2	2	.
Bituminaria bituminosa	+	+	.	.	.	.
Spartium junceum	.	.	.	2	1	.
Cistus creticus subsp. eriocephalus	.	.	.	.	1	2
Althaea hirsuta	1	.	.	.	.	.
Olea europea	.	.	.	1	.	.
Scabiosa maritima	.	.	.	+	.	.
Elaeoselinum asclepium	.	.	.	+	.	.
Antirrhinum majus subsp. majus	.	.	.	.	1	.
Phoeniculum vulgare	.	.	.	.	+	.
Micromeria graeca	.	.	.	.	+	.
Galactites tomentosa	.	.	.	.	+	.
Rosmarinus officinalis	.	.	.	.	.	3

Hippocrepis emerus subsp. emeroides	1
Cisto eriocephali - Ericion multiflorae	
Rosmarinetalia officinalis	
Rosmarinetea officinalis	
Rosmarinus officinalis	4
Erica multiflora	2
Species from Quercetea ilicis	
Pistacia lentiscus	+
Rhamnus alaternus	1
Phillyrea latifolia	+
Asparagus acutifolius	+
Smilax aspera	1

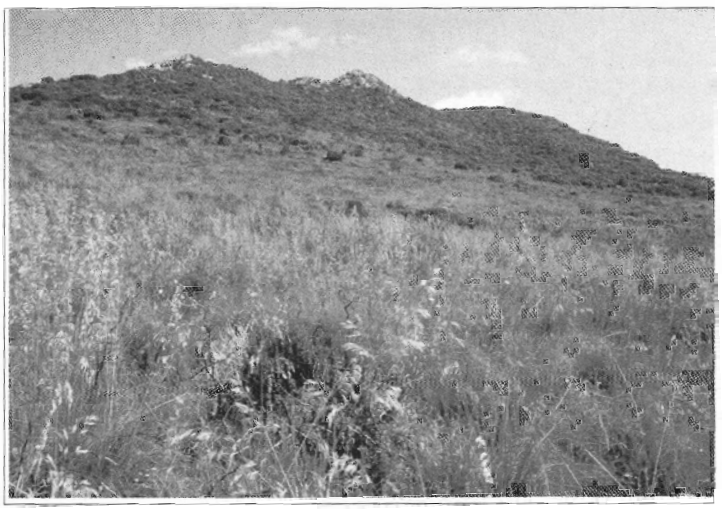

Fig. 16 - Footslope of "Quarto caldo" with *Ampelodesmos mauritanicus* stands (*Elaeoselino-Ampelodesmetum*)

ERICO MULTIFLORAE-ROSMARINETUM OFFICINALIS Di Pietro, Filesi & Blasi 2002 in press
CISTETOSUM MONSPELIENSIS Di Pietro, Filesi & Blasi 2002 in press

The *Cistus monspeliensis* low maquis can reach a very thick covering, with heights up to one and a half metres, and is dominated by the nanophanerophytes *Cistus monspeliensis*, *Erica multiflora* and *Rosmarinus officinalis* (Di Pietro *et al.*, 2002, in press). This community regularly has bushes of *Ampelodesmos mauritanicus* and, less frequently, individuals of *Cistus incanus* and *Dorycnium pentaphyllum*. From the syntaxonomic point of view, it has been included in the *Erico multiflorae-Rosmarinetum officinalis cistetosum monspeliensis* (Tab. 13). Generally, it is found on a less harsh morphology, at lower heights with respect to *Erico-Rosmarinetum tipycum*.

Quarto Caldo is now occupied by a mosaic of vegetation mainly made up of *Ampelodesmos mauritanicus* formations, terophyte grasses, Mediterranean sclerophyllous maquis, low shrubs of *Cistus, Erica, Rosmarinus* and, sporadically, strips of evergreen wood.

ELAEOSELINO ASCLEPII-AMPELODESMETUM MAURITANICI Filesi, Blasi & Di Marzio 1996 (Fig. 16)

This is a formation closely connected to strong disturbances (arising, above all, from fires), to which the vegetation of the southern aspects has been repeatedly subjected. Besides *Ampelodesmos mauritanicus*, there is the presence of *Elaeoselinum asclepium*, species particularly connected with fires and eroded soils of a carbonatic make-up. Also frequent in the community are *Brachypodium retusum, Psoralea bituminosa* and *Micromeria graeca* (Filesi *et al.*, 1996). Furthermore there is almost always the presence of *Erica multiflora*, that underlines the dynamic relation that runs between *Elaeoselino-Ampelodesmetum* (Tab. 14) and *Erico-Rosmarinetum*.

Rel. 19. *Elaeoselino asclepii-Ampelodesmetum mauritanici* Filesi, Blasi & Di Marzio 1996

Elaeoselino asclepii-Ampelodesmetum mauritanici

Ampelodesmos mauritanicus	3
Cistus monspeliensis	2
Elaeoselinum asclepium	+
Cisto eriocephali - Ericion multiflorae	
Rosmarinetalia	
Rosmarinetea officinalis	
Erica multiflora	3
Rosmarinus officinalis	+
Dorycnium hirsutum	1
Other species	
Prasium majus	+
Brachypodium retusum	2
Scorpiurus muricatus	+
Daucus carota	+
Linum corymbulosum	+

CRUCIANELLO LATIFOLIAE-HYPOCHOERIDETUM ACHYROPHORI Filesi, Blasi & Di Marzio 1996

In form of a typical mosaic with the *Elaeselino-Ampelodesmetum*, there are terophytic grasslands attrib-

uted to *Crucianello-Hypochoeridetum* (Tab. 15), with characteristic and differential species *Crucianella latifolia, Hypochoeris achyrophorus, Coronilla scorpioides, Scorpiurus muricatus, Lotus ornithopodioides, Catapodium rigidum, Trifolium campestre,* and *Linum strictum* (Filesi *et al.*, 1996), linked to the *Trachynion distachyae* alliance (Rivas-Martinez, 1978).

Rel. 20. *Crucianello latifoliae-Hypochoeridetum achyrophori* Filesi, Blasi & Di Marzio 1996

Crucianello latifoliae-Hypochoeridetum achyrophoris	
Hypochoeris achyrophorus	2
Scorpiurus muricatus	1
Lotus ornithopodioides	+
Crucianella latifolia	+
Trachynion distachyae	
Trachinietalia distachyae	
Helinthemetea guttati	
Linum corymbulosum	+
Linum strictum	+
Trifolium campestre	+
Brachypodium distachyum	+
Other species	
Bituminaria bituminosa	1
Elaeoselinum asclepium	2
Nigella damascena	+
Anagallis arvensis	+
Sonchus tenerrimus	2
Avena barbata	+
Briza maxima	1
Sonchus asper	1
Misopates orontium	+
Asparagus acutifolius	+

The ideal continuation of the excursion

OLEO-JUNIPERETUM PHOENICEAE Arrigoni, Bruno, De Marco &Veri 1985

In the western area of the Promontory (beyond the Punta Rossa), in the area that has remained free from holiday settlements, there are extensive strips of a shrub-forest of *Juniperus phoenicea* that here probably reach their highest structural and floristic complexity. This is a formation that grows mainly on steep slopes (the ancient cliffs), on the rendzina soils.

The formation is rather persistent (at least 80% coverage), and with a multistratified structure. In the dominant layer, *Juniperus phoenicea* reaches 4 metres, while the low-shrub layer (up to a height of 2 metres) is made up of *Pistacia lentiscus, Rhamnus alaternus*, *Phillyrea latifolia* and *Myrtus communis*; also abundant are the vines *Lonicera implexa* and *Prasium majus.* The herbaceous species are scarsely represented, with the exception of *Arisarum vulgare* that can show a local abundance.

These formations can be considered as the local expression of *Oleo-Juniperetum phoeniceae*, an association described by Arrigoni *et al.* (1985) for the limestone relief of Sardinia.

Oleo-Juniperetum phoeniceae is often replaced here by a the maquis of *Myrto-Lentiscetum* that, in the area of Quarto Caldo, is widespread, replacing the *Quercus ilex* wood too.

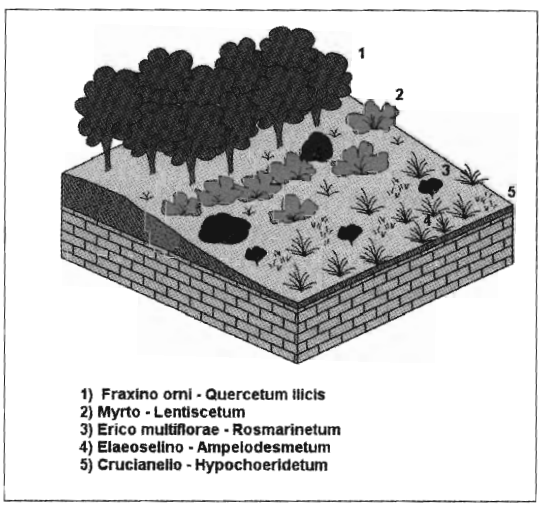

Fig. 17 - *Fraxino orni-Querceto ilici sygmetum*

Locally, on the ledge sites that are more exposed to the sea winds, this community becomes enriched by the presence of *Euphorbia dendroides* .

Oleo-Juniperetum phoeniceae can come into serial contact with the suffruticoses of *Helichrysum litoreum.*

RHAMNO ALATERNI-EUPHORBIETUM DENDROIDIS Géhu & Biondi 1997

Another primary type of woody formations in rocky areas is represented by residual *Chamaerops humilis* population together with not only *Euphorbia dendroides*, but also *Prasium majus*, and, more rarely *Anthyllis barba-jovis.* These populations are attributed to *Rhamno-Euphorbietum dendroidis* (Géhu & Biondi,

1997). A possible catenal contact can just be seen in the herbaceous community of cliffs by *Phagnalon rupestre* and *Centaurea cineraria subsp. circae.*

At the same time, in the area there are communities dominated by *Euphorbia dendroides* that can be included in the coenological range of the *Erico-Rosmarinetum.*

HELICHRYSUM LITOREUM formations

This formation occupies an area that is still greatly influenced by the action of the sea spray, but that is by now free from the mechanical disturbance of the waves.

It grows on the lithosoils or on the extremely superficial soils, and is found sporadically also on rocks inland from the coast, as in the case of some rocky sites above Torre Paola (the area of Quarto Freddo most exposed to the influence of the sea).

It is a formation with high plant cover (70-80%). The physionomy of this form of vegetation is mainly characterised by *Helichrysum litoreum.* This aggregation can be referred to the *Crithmo-Staticion.* It also includes some of the species already met above, among which are *Lotus cytisoides, Reichardia picroides* and *Daucus gingidium,* as well as populations of species that are normally found in the garrigue, and in the phanerophytic formations dynamically linked to the garrigue, such as *Brachypodium retusum* and *Dactylis hispanica.*

Limitedly Zannone island this aggregation can be included in that which can be given the rank of an association: *Senecioni-Helichrysetum litorei* (Barbagallo *et al.*, 1983), in analogous locations on Eolie Island. The geographical distribution of that community is limited to the south Tyrrhenian coast, and towards the north up to the Ponziane Islands, reaching also the Sorrento Peninsula, Ischia and Capri (Bartolo *et al.*, 1989).

In Circeo the *Helichrysum litoreum* formations enters in contact with the maquis-forest of *Juniperus phoenicea* or with *Chamaerops humilis* formations. This type of suffruticose comunities is notably stable, and as such it appears difficult to hypothesise its evolution towards vegetation of a more complex stucture. There are, however, communities that having developed in less exposed areas and on deeper soils, host consistent patches of evergreen phanerophytes (in particular *Pistacia lentiscus* and *Smilax aspera*), which are linked to the recover of maquis-forest of *Juniperus phoenicea* (*Rhamno-Juniperetum phoeniceae*).

Rel. 21. *Helycrhisum litoreum* community type

Crithmo - Staticion	
Crithmo-Staticetalia	
Crithmo-Staticetea	
Helychrysum litoreum	4
Daucus gingidium	2
Lotus cytisoides	3
Crithmum maritimum	1
Other species	
Brachypodium ramosum	1
Euphorbia dendroides	1

CRITHMO-LIMONIETUM CIRCEI Bartolo, Brullo, Signorello 1989

The best examples of this vegetation are found on the coastal cliffs of Riparo Blanc, periodically disturbed by the mechanical actions of the waves, and constantly covered by the sea water spray.

The extremely specialised alophytic vegetation, with a sparse covering, is mainly made up of the population of *Crithmum maritimum* and of the endemic species of *Limonium circaei.* These two little chamephytes are accompanied by few salt-tolerant and generally not rock-growing species, of which there are *Daucus gingidium, Reichardia picroides, Lotus cytisoides* and *Catapodium marinum.* As with the major part of the markedly specialised coastal plant communities, this coenoses grows in a very narrow strip of territory.

Limonium circaei confers the endemic character to the entire community, which can be given the rank of an association: *Crithmo-Limonietum circei* (Bartolo *et al.*,1989). Lucchese *et al.* (1990) prefer to include this grouping in *Crithmo-Limonietum multiformis*, previously described by Arrigoni *et al.* (1985) for Tuscany. This is with the aim of emphasising the substantial coenological continuity of these coastal populations in the belt that goes from Tuscany to Campania. Indeed, the only differentiated species is just *Limonium circaei,* that Pignatti (1982) considered to be a local **race** of the group of species that are led by *Limonium multiforme.*

Its dynamic evolution is blocked by the continuous disturbances due to the sea waves, and therefore there are no explicit seral contacts that can be seen with the surrounding formations. The inferior catenal contact is made with the cryptogamic vegetation that grows on the bare cliffs facing the sea, while above they make contact with the vegetation dominated by *Helichrysum litoreum.*

Rel. 22. *Crithmo-Limonietum circaei* Bartolo, Brullo, Signorello 1989

Crithmo - Limonietum circaei	
Crithmo - Staticion	
Crithmo-Staticetalia	
Crithmo - Staticetea	
Crithmum maritimum	2
Limonium circaei	3
Sporobolus pungens	1

CYMBALARIETUM PILOSAE Biondi, Casavecchia, Pinzi 1999 (Tab. 23)

The association, endemic for a short sector of the Tyrrhenian coast between S. Felice Circeo and Gaeta, is characterised by the presence of *Cymbalaria pilosa* (Jacq.) L. H. Bailey, an endemic species distributed along the Tyrrhenian coasts from Circeo to Calabria, developing on calacareous rocks and old and shady walls.

The association belongs to the *Parietarietea judaicae* class, within which it substitutes the *Cymbalarietum muralis* Görs 1966 association. Of the same association has been described the *crithmetosum maritimi* subassociation representing the contact element with the *Crithmo-Staticetea* class.

Rel. 23. *Cymbalarietum pilosae* Biondi, Casavecchia & Pinzi 1999

Cymbalarietum pilosae	
Cymbalaria pilosa	2.2
Parietarietea judaicae	
Tortulo cymbalarietalia	
Parietarion judaicae	
Sonchus tenerrimus	+
Umbilicus rupestris	2.3
Ficus carica L. var. caprificus	+
Antirrhinum tortuosum	1.2
Other species	
Dianthus rupicola	+.2
Centaurea cineraria L. ssp. circae	+.2

Syntaxonomical scheme

CAKILETEA MARITIMAE R. Tüxen. & Preising. ex Br.-Bl. & Tüxen 1952
- *Cakiletalia integrifoliae* Tüxen ex Oberdorfer 1949 corr. Rivas-Martínez, Costa & Loidi 1992
  - *Cakilion maritimae* Pignatti 1953
    - *Salsolo kali-Cakiletum aegyptiacae* Costa & Manzanet 1981

AMMOPHILETEA Br.-Bl. & Tüxen ex Westhoff, Dijk & Passchier 1946
- *Ammophiletalia* Br.Bl. 1933
  - *Ammophilion astralis* Br.Bl. 1921 corr. Rivas-Martínez, Costa & Izco in Rivas-Martínez, Lousã , T. E. Díaz, Fernández-González & J.C. Costa 1990
    - *Echinophoro spinosae-Elytrigetum junceae* Géhu 1988 corr. Géhu 1996
    - *Echinophoro spinosae-Ammophiletum australis* (Br.-Bl. 1921) Géhu, Rivas Martínez & R.Tx. in Géhu 1975

HELICHRYSO-CRUCIANELLETEA MARITIMAE Géhu, Rivas Martínez & Tüxen *ex* Bon & Géhu 1973
- *Crucianelletalia maritimae* Sissingh 1974
  - *Crucianellion maritimae* Rivas-Goday & Rivas-Martínez 1958
    - *Pycnocomo rutifolii - Crucianelletum maritimae* Géhu, Biondi, Géhu -Frank & Taffetani, 1987

CRITHMO-STATICETEA Br.-Bl. *in* Br.-Bl. & Nègre 1952
- *Crithmo-Staticetalia* Molinier 1934
  - *Crithmo-Staticion* Molinier 1934

Crithmo-Limonietum multiformis Arrigoni, Nardi & Raffaelli 1985
Crithmo-Limonietum circaei Bartolo, Brullo & Signorello 1989
Senecioni-Helichrysetm litorei Barbagallo, Brullo & Signorello 1983

PARIETARIETEA JUDAICAE Oberd. 1977
Tortulo-Cymbalarietalia Segal 1964
Parietarion judaicae Segal 1964
Cymbalarietum pilosae Biondi, Casavecchia & Pinzi 1999

HELIANTHEMETEA GUTTATI (Br.Bl. in Br.-Bl., Roussine & Nègre 1952) Rivas-Goday & Rivas-Martínez 1963 em. Rivas-Martinez 1978
Trachynietalia dystachyae Rivas-Martínez 1978
Trachynion dystachyae Rivas-Martínez 1978
Crucianello latifoliae-Hypochoeridetum achyrophori Filesi, Blasi & Di Marzio 1996
Malcolmietalia Rivas-Goday 1958
Laguro-Vulpion membranaceae Géhu & Biondi 1994
Sileno coloratae-Vulpietum membranaceae (Pignatti 1953) Géhu & Scoppola 1984
Heliantemetalia guttati Br.-Bl. in Br.-Bl. Molinier & Wagner 1940
Heliantemion guttati Br.-Bl. in Br.-Bl. Molinier & Wagner 1940
Moenchio-Tuberarietum guttati

ISOETO-NANOJUNCETEA Br.-Bl. & Tüxen ex Westhoff, Dijk & Passchier 1946
Isoetetalia Br.-Bl. 1936
Cicendio-Solenopsion laurentiae Brullo & Minissale 1998
Sileno laetae-Isolepetum cernuae Blasi, Stanisci, Filesi, Milanese, Perinelli & Riggio 2002 in press

ROSMARINETEA OFFICINALIS (Br.-Bl. 1947) Rivas-Martínez, Diaz, Prieto, Loidi, Penas ex Rivas-Martínez, Fernandez Gonzales, Loidi, Lousa & Penas 2001
Rosmarinetalia officinalis Br.-Bl. (1931) 1952
Cisto ericephali – Ericion multiflorae Biondi 2000
Elaeoselino asclepii-Ampelodesmetum mauritanici Filesi, Blasi & Di Marzio 1996
Erico multiflorae-Rosmarinetum officinalis Di Pietro, Filesi & Blasi 2002 in press
Erico multiflorae-Rosmarinetum cistetosum monspeliensis Di Pietro, Filesi & Blasi 2002 in press

QUERCETEA ILICIS Br.-Bl. ex A. & O. Bolòs 1950
Quercetalia ilicis Br.-Bl. ex Molinier 1934
Quercion ilicis Br.-Bl. ex Molinier 1934
Fraxino orni-Quercetum ilicis Horvatic 1958
Fraxino orni -Quercetum ilicis ostryetosum Trinajstic 1965
Fraxino orni -Quercetum ilicis suberetosum Selvi & Viciani 1998
Fraxino orni -Quercetum ilicis Horvatic 1958 *Pistacia terebinthus* variant
Fraxino orni -Quercetum ilicis Horvatic 1958 *Juniperus phoenicea* variant
Viburno tini-Quercetum ilicis (Br.-Bl. ex Molinier 1934) Rivas-Martínez 1975
Viburno tini -Quercetum ilicis quercetosum roboris Arrigoni 1997
Pistacio lentisci-Rhamnetalia alaterni Rivas-Martínez 1975
Juniperion turbinatae Rivas-Martínez 1975 corr. 1987
Asparago-Juniperetum macrocarpae (R.& R.Molinier 1955) O.Bòlos 1962
Phillyreo-Juniperetum phoeniceae Arrigoni, Nardi & Raffaelli 1985
Oleo-Ceratonion siliquae Br.-Bl. ex Guinochet & Drouineau 1944
Oleo-Juniperetum phoeniceae Arrigoni, Bruno, De Marco &Veri 1985
Myrto-Lentiscetum (Molinier (1936) 1954 em. Bolos 1962) Rivas-Martínez 1975

Rhamno-Euphorbietum dendroidis Géhu & Biondi 1997
Ericion arboreae (Rivas-Martínez ex Rivas-Martínez, Costa & Izco 1986) Rivas-Martínez 1987
Erico arboreae – Arbutetum unedonis Molinier 1937
Phillyreo latifoliae-Ericetum scopariae Blasi, Stanisci, Filesi, Milanese, Perinelli & Riggio 2002 in press
Cytiso villosi - Ericetum arboreae Zéller 1959 (coll. pref.)

QUERCO ROBORIS-FAGETEA SYLVATICAE Br. Bl. & Vlieger in Vlieger 1937
Quercetalia pubescenti-petraeae Klika 1933 corr. Moravec in Béguin & Theurillat 1984
Lonicero etruscae-Quercion pubescentis Arrigoni & Foggi 1988 *ex* Arrigoni in Arrigoni, Mazzanti & Ricceri 1990
Mespilo germanicae-Quercetum frainetto Biondi, Gigante, Pignattelli & Venanzoni 2001
Mespilo germanicae-Quercetum frainetto quercetosum roboris Biondi, Gigante, Pignattelli & Venanzoni 2001
Mespilo germanicae-Quercetum frainetto arbutetosum unedonis Blasi, Stanisci, Filesi, Milanese, Perinelli & Riggio 2002 in press
Quercetum frainetto-suberis Blasi, Filesi, Fratini & Stanisci 1997
Ostryo-Carpinion orientalis Horvat (1956) 1958
Asparago acutifolii – Ostryetum carpinifoliae Biondi 1982
Populetalia albae Br.Bl. ex Tchou 1948
Populion albae Br.Bl. ex Tchou 1948
Cladio marisci-Fraxinetum oxycarpae Piccoli, Gerdol & Ferrari 1983
Cladio marisci-Fraxinetum oxycarpae caricetosum otrubae Stanisci, Presti & Blasi 1998
Veronico scutellatae-Quercetum roboris Stanisci, Presti & Blasi 1998

RHAMNO-PRUNETEA SPINOSAE Rivas-Goday & Borja ex Tüxen 1962
Prunetalia spinosae Tüxen 1952
Pruno-Rubion ulmifolii O. de Bolòs 1954
Pruno-Rubenion ulmifolii
Daphno gnidii-Cytisetum scoparii Blasi, Stanisci, Filesi, Milanese, Perinelli & Riggio 2002 in press

Tab. 13 - *Erico multiflorae-Rosmarinetum officinalis* Di Pietro, Filesi & Blasi 2002 in press

Releves Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Exposition	SSW	SSE	S	SSW	S	S	S	S	SSW	SSE	SSE	S	S	S	S	S
Inclination (°)	45	45	55	45	45	40	55	45	20	35	40	20	15	20	25	35
Altitude (m)	345	285	280	270	245	205	200	195	210	165	155	140	30	80	90	140
Area (m^2)	40	50	30	20	90	40	45	40	30	50	80	20	20	20	25	30
Erico multiflorae-Rosmarinetum officinalis Di Pietro, Filesi & Blasi 2002 in press																
Ampelodesmos mauritanicus	1	1	2	2	2	2	2	1	3	2	2	+	2	1	2	1
Teucrium flavum	+	1	1	+	+	+	1	+	.	1	+	2	.	.	.	.
Hippocrepis emerus subsp. emeroides	+	+	1	1	2	1	1	2	+	1	+	.	.	.	.	.
Erico multiflorae-Rosmarinetum officinalis cistetosum monspeliensis Di Pietro, Filesi & Blasi 2002 in press																
Cistus monspeliensis	.	.	.	.	.	.	.	.	.	1	1	1	3	2	3	3
Cisto eriocephali - Ericion multiflorae Biondi 2000																
Rosmarinetalia officinalis Br.-Bl. (1931) 1952																
Rosmarinetea officinalis (Br.-Bl. 1947) Rivas-Martínez, Diaz, Prieto, Loidi, Penas ex Rivas-Martínez, Fernandez Gonzales, Loidi, Lousa & Penas 2001																
Rosmarinus officinalis	4	4	3	4	4	4	4	4	2	3	4	3	3	3	2	4
Erica multiflora	3	3	3	2	3	3	3	4	2	4	4	3	3	3	3	3
Fumana laevipes	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.
Cistus creticus subsp. eriocephalus	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Fumana arabica	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Dorycnium hirsutum	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Species from Quercetea ilicis Br.-Bl. ex A. & O. Bolòs 1950																
Pistacia lentiscus	+	.	+	+	+	1	+	+	1	1	+	1	.	1	1	1
Rhamnus alaternus	.	1	1	1	+	.	1	+	.	.	+	1	.	1	.	.
Phillyrea latifolia	+	+	.	+	+	+	+	1	.	1	.	.	.	.	.	.
Rubia peregrina	+	+	+	.	.	.	+	+	+	.	.	.	.	+	.	.
Juniperus phoenicea	.	.	.	.	+	+	.	+	.	1	1	.	1	.	.	.
Asparagus acutifolius	+	.	.	+	.	.	.	.	.	.	+	.	1	.	.	.
Quercus ilex	.	.	+	.	+	.	+	+	.	.	+	.	.	.	.	.
Smilax aspera	.	1	.	1	.	.	+	+	.	.	.	.	.	.	.	.
Lonicera implexa	.	+	.	.	+	+	.	+	.	.	.	.	.	.	.	.
Prasium majus	.	+	.	.	.	.	.	.	1	.	.	2	.	.	1	.
Euphorbia dendroides	.	.	.	.	.	.	.	.	3	1	1	.	.	.	.	.
Pistacia terebinthus	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Arbutus unedo	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.
Myrtus communis	.	.	.	.	.	+	.	.	1	.	.	.	.	.	.	.
Chamaerops humilis	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Other species																
Brachypodium retsum	1	1	.	.	+	.	1	.	2	.	.	1	.	1	2	1
Elaeoselinum asclepium	+	.	.	.	.	.	.	.	1	+	+	.	2	.	.	.
Fraxinus ornus	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Osyris alba	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Bituminaria bituminosa	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.
Antirrhinum majus	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Scorpiurus muricatus	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Anagallis arvensis	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Catapodium rigidum	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Linum strictum	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Phagnalon rupestre	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Hyparrhenia hirta	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Allium ampeloprasum	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Allium sphaerocephalon	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Hippocrepis ciliata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+

Tab. 14 - *Elaeoselino asclepii-Ampelodesmetum mauritanici* Filesi, Blasi & Di Marzio 1996

Releves Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Exposition	S	S	SSE	S	S	S	S	SSE	S	S	S	S	SSW	SSW	SSW
Inclination (°)	20	15	30	35	15	20	25	25	20	20	15	35	20	5	20
Altitude (m)	30	7	16	14	8	10	15	14	13	13	33	14	55	120	210
Elaeoselino asclepii-Ampelodesmetum mauritanici Filesi, Blasi & Di Marzio 1996															
Ampelodesmos mauritanicus	4	5	4	3	5	5	4	3	4	4	4	1	5	4	3
Cistus monspeliensis	1	2	1	2	1	1	2	2	3	3	1	3	.	3	.
Elaeoselinum asclepium	+	2	2	2	3	3	.	+	.	1	1	.	.	.	1
Micromeria graeca	.	.	.	.	.	+	+	.	+	.	.	.	.	1	.
Cisto eriocephali - Ericion multiflorae Biondi, 2000															
Rosmarinetalia officinalis Br.-Bl. (1931) 1952															
Rosmarinetea officinalis (Br.-Bl. 1947) Rivas-Martínez, Diaz, Prieto, Loidi, Penas ex Rivas-Martínez, Fernandez Gonzales, Loidi, Lousa & Penas 2001															
Erica multiflora	3	2	3	3	1	2	3	3	2	2	3	3	3	2	2
Rosmarinus officinalis	.	.	.	.	.	.	1	+	+	1	.	4	.	+	2
Dorycnium hirsutum	.	.	.	1	.	.	1	1	.	.	+	.	.	1	.
Cistus creticus subsp. eriocephalus	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Species from Quercetea ilicis Br.-Bl. ex A. & O. Bolòs 1950															
Prasium majus	.	1	1	+	1	.	+	+	1	+	.	.	+	.	1
Rubia peregrina	.	+	.	.	.	.	.	.	.	+	+	.	+	.	+
Pistacia lentiscus	.	.	.	.	.	.	.	.	.	.	2	1	+	+	1
Myrtus communis	.	.	.	.	+	.	.	.	.	.	.	.	2	1	1
Euphorbia dendroides	1	.	.	.	.	.	.	.	.	+	.	.	.	.	3
Asparagus acutifolius	.	+	.	.	.	.	.	.	.	.	+	.	1	.	.
Lonicera implexa	.	.	.	.	.	+	.	.	.	.	+	.	1	.	.
Arisarum vulgare	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.
Smilax aspera	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Daphne gnidium	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Phillyrea latifolia	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Arbutus unedo	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Other species															
Brachypodium retusum	1	1	1	2	.	+	1	2	2	1	1	1	.	2	2
Bituminaria bituminosa	2	1	1	1	1	2	+	.	+	+	+	.	+	2	2
Scorpiurus muricatus	.	.	.	.	.	.	.	+	.	.	.	.	.	1	1
Hypochoeris achyrophorus	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.
Hyparrhenia hirta	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.
Sonchus tenerrimus	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.
Sonchus asper	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.
Daucus carota	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.
Briza maxima	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.
Hippocrepis emerus subsp. emeroides	.	.	.	.	.	.	.	.	.	.	.	.	2	.	+
Geranium purpureum	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Vicia sativa	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Nigella damascena	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Linum corymbulosum	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Anthyllis vulneraria	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Antirrhinum tortuosum	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Linum bienne	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Coronilla scorpioides	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Dactylis hispanica	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Dianthus balbisii	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Galium corrudifolium	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Hippocrepis ciliata	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Blackstonia perfoliata	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Rhamnus alaternus	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Lotus ornithopodioides	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Ornithopus compressus	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Antirrhinum majus subsp. majus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Catapodium rigidum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Anagallis arvensis subsp. arvensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Fumana laevipes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Linum strictum subsp. strictum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+

Tab. 15 - *Crucianello latifoliae-Hypochoeridetum achyrophoris* Filesi, Blasi & Di Marzio 1996

Releves Number	1	2	3	4	5	6	7	8
Exposition	S	S	S	S	SSE	S	S	_
Inclination (°)	10	15	20	15	30	20	20	_
Altitude (m)	340	330	100	80	160	130	130	120
Crucianello latifoliae-Hypochoeridetum achyrophoris Filesi, Blasi & Di Marzio 1996								
Hypochoeris achyrophorus	2	1	2	2	1	2	2	3
Coronilla scorpioides	1	2	1	.	2	2	2	.
Scorpiurus muricatus	1	.	+	1	3	3	1	.
Catapodium rigidum	2	+	+	.	.	+	.	+
Lotus ornithopodioides	1	+	.	+	.	+	+	2
Crucianella latifolia	.	+	+	+	+	.	2	.
Trachynion distachyae Rivas-Martinez 1978								
Trachinietalia distachyae Rivas-Martinez 1978								
Helinthemetea guttatae (Br.Bl. in Br.-Bl., Roussine & Nègre 1952) Rivas-Goday & Rivas-Martínez 1963								
Linum corymbulosum	+	.	+	+	+	+	+	.
Linum strictum	.	+	2	+	+	1	2	.
Trifolium campestre	.	+	.	+	.	+	.	1
Galium parisiense	+	+	.	.	.	.	.	.
Hippocrepis ciliata	+	.	.	.	.	.	.	.
Sideritis romana	.	.	+	.	.	.	.	.
Brachypodium distachyum	.	.	.	+	.	.	.	.
Other species								
Bituminaria bituminosa	+	+	2	1	1	1	1	.
Brachypodium retusum	1	+	+	.	1	1	+	.
Elaeoselinum asclepium	1	1	3	2	2	.	.	.
Gastridium ventricosum	2	+	.	.	+	1	.	.
Hippocrepis unisiliquosa	+	+	.	.	.	+	+	.
Allium tenuiflorum	.	+	.	.	+	+	+	.
Nigella damascena	.	.	+	+	2	.	.	+
Anagallis arvensis	.	.	.	+	+	+	.	+
Sherardia arvensis	+	+	.	.	.	.	.	2
Sonchus tenerrimus	.	+	1	2	.	.	.	.
Avena barbata	.	+	+	+	.	.	.	.
Briza maxima	.	+	.	1	.	.	.	2
Sonchus asper	.	.	+	1	+	.	.	.
Misopates orontium	.	.	.	+	+	.	+	.
Pulicaria odora	+	+	.	.	.	.	.	.
Allium sphaerocephalon	.	.	.	.	+	.	+	.
Salvia pratensis	+	.	.	.	.	.	.	.
Fumana thymifolia	.	1	.	.	.	.	.	.
Blackstonia perfoliata	.	+	.	.	.	.	.	.
Dactylis hispanica	.	+	.	.	.	.	.	.
Dianthus balbisii	.	+	.	.	.	.	.	.
Galium corrudifolium	.	+	.	.	.	.	.	.
Melilotus sulcata	.	+	.	.	.	.	.	.
Micromeria graeca	.	+	.	.	.	.	.	.
Trifolium angustifolium	.	+	.	.	.	.	.	.
Asparagus acutifolius	.	.	.	+	.	.	.	.
Sonchus oleraceus	.	.	.	.	+	.	.	.
Daucus carota	.	.	.	.	.	+	.	.
Anthyllis vulneraria	.	.	.	.	.	+	.	.
Cistus monspeliensis	.	.	.	.	.	.	+	.
Cynosurus echinatus	.	.	.	.	.	.	.	3
Linum bienne	.	.	.	.	.	.	.	2
Bromus madritensis	.	.	.	.	.	.	.	1
Stachys ocymastrum	.	.	.	.	.	.	.	+
Trifolium cherleri	.	.	.	.	.	.	.	+
Geranium columbinum	.	.	.	.	.	.	.	+
Geranium purpureum	.	.	.	.	.	.	.	+
Euphorbia peplus	.	.	.	.	.	.	.	+
Avena sterilis	.	.	.	.	.	.	.	+

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