Fitosociologia 39 (1) - 23-43, 2002

Syndynamics of lowland *Quercus frainetto* & *Q. cerris* forests in Lazio (central Italy)

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Abstract

Syntaxonomy and syndynamics of residual natural vegetation of Lazio lowland have been analysed using 120 original phytosociological relevés. Data matrix were subjected to classification and ordination techniques.

The mesophytic forest of the lowland can be included in the *Mespilo germanicae-Quercetum frainetto* association, *Teucrio siculi-Quercion cerridis* alliance. Three subassociations have been recognized: *arbutetosum unedonis* subass.nova, *cornetosum sanguineae* subass. nova and subass. *quercetosum roboris*. Main serial contacts are described: mantles are referred to the new associations *Daphno gnidii-Cytisetum scopariae (Pruno-Rubenion ulmifolii)*, shrublands to the new association *Phillyreo latifoliae-Ericetum scopariae* (*Ericion arboreae*), grassland to the *Moenchio-Tuberarietum guttatae (Helianthemion guttatae)*, and a small community of ephemeral ponds to the new association *Sileno laetae-Isolepetum cernuae (Cicendio-Solenopsion laurentiae).*

Catenal contacts were also analysed and discussed.

Key words: lowland, *Quercus frainetto*, syndynamics, syntaxonomy.

Riassunto

Sindinamica dei boschi planiziari a Quercus frainetto *&* Q. cerris *nel Lazio (Italia centrale).* Nel presente lavoro si analizza la vegetazione naturale residuale dell'ambiente planiziare del Lazio, utilizzando 120 rilievi fitosociologici originali.

Le matrici dei dati sono state classificate con tecniche di analisi multivariata.

La foresta mesofitica planiziare viene riferita al *Mespilo germanicae-Quercetum frainetto*, dell'alleanza *Teucrio siculi-Quercion cerridis*; tre subassociazioni sono state individuate: *arbutetosum unedonis subass. nova, cornetosum sanguineae subass. nova* e *quercetosum roboris.* Vengono descritti i principali contatti seriali: i mantelli sono inclusi nella nuova associazione *Daphno gnidii-Cytisetum scopariae (Pruno-Rubenion ulmifolii)*, gli arbusteti nella nuova associazione *Phillyreo latifoliae-Ericetum scopariae* (*Ericion arboreae*), le praterie nel *Moenchio-Tuberarietum guttatae (Helianthemion guttatae)*, e le comunità terofitiche delle pozze temporanee nella nuova associazione *Sileno laetae-Isolepetum cernuae (Cicendio-Solenopsion laurentiae).*

Vengono analizzati e discussi anche i principali contatti catenali.

Parole chiave: ambiente planiziare, *Quercus frainetto*, sindinamica, sintassonomia.

Introduction

Quercus frainetto is a southeastern European deciduous broadleaf oak, found in central and southern Italy, mainly on subacid and well drained soils of lowlands and hills (Abbate *et al.*, 1990). In central Italy it is common in the subcoastal and hilly parts of Lazio, becoming rarer to the north and reaching the northwestern limit of its geographical distribution in Tuscany and Umbria (Abbate *et al.*, 1990; Arrigoni *et al.,* 1990; Biondi *et al.* 2001; Catorci & Orsomando, 1998; Contoli & Spada, 1974; Paura & Abbate, 1995).

In the northern part of central Italy (southern Tuscany, Umbria) *Quercus frainetto* is rare, occurring in *Q. cerris* woods of the *Erico-Quercetum cerridis*, *Melico uniflorae-Quercetum cerridis* and *Malo florentinae-Quercetum frainetto* associations (Arrigoni *et al.*, 1990; Biondi *et al.*, 1995; Biondi *et al.* 2001; Catorci & Orsomando, 1998).

In the Lazio region, the first phytosociological studies of oak forests with *Quercus frainetto* in the tuff and calcareous hill belt (Blasi, 1984) and in the subcoastal area (Blasi & Spada, 1984) showed their coenological affinity with the Balkan alliance *Quercion frainetto-cerridis*, and two associations were recognised: *Quercetum frainetto-cerridis*, on clayey soils, and *Carpino orientalis-Quercetum cerridis*, on soils derived from limestone. Recently Pignatti (1998) refers the *Quercus frainetto* forests of Lazio to the *Echinopo siculi-Quercetum frainetto* association, which was described by Blasi & Paura (1995) and includes *Quercus frainetto* and *Q. cerris* forests, rich in southern Italian endemic and southeastern European species, on sandstone soils in Molise and Campania. Furthermore, for *Quercus*

suber and *Q. frainetto* mixed forest of central Italy the *Quercetum frainetto-suberis* association was described (Blasi *et al.*, 1997). More recently Biondi *et al.* (2001) described the *Mespilo germanicae-Quercetum frainetto* association for the Lazio tableland, on siliceous and tuff soils with a mesomediterranean bioclimate. These communities belong to the alliance *Teucrio siculi-Quercion cerridis*, which is the Italian counterpart of the Balkan *Quercion frainetto-cerridis*, consisting of subacidophilous forests with *Quercus cerris* of the sub-Mediterranean and submontane bioclimatic belts of central-southern Italy (Scoppola & Filesi, 1995; Scoppola *et al.*, 1995).

On the contrary, towards the south (Basilicata, Calabria) *Quercus frainetto* is widespread and occurs with several endemic or Mediterranean-mountain species (Scelsi & Spampinato, 1996), so another alliance, *Melittio-Quercion frainetto*, was described (Abbate *et al.*, 1990; Bonin & Gamisans, 1976; Zanotti *et al.*, 1995).

In Italy, lowland forests are now quite rare having been largely replaced by lands for crops and livestock since the beginning of the last century (Almagià, 1976; Blasi *et al.*, 1995; Milanese *et al.*, 1998). The drainage of subcoastal marshes has deeply modified the original landscape and has reduced the natural vegetation to small scattered patches.

Syndynamics of lowland oak forest is still not well known, even if the floristic and coenological knowledge of its different successional stages could be largely used in applied vegetation studies (e.g. nature conservation, environmental restoration, land management) (Blasi *et al.*, 2000).

The aim of this paper is to describe the serial and catenal contacts of the lowland *Quercus frainetto* forest in the Lazio region, by a synchronic analysis of the residual vegetation patches.

Study area and physical environment

The study area is in the subcoastal zone of southern Lazio, between 41°13' and 41°30' North and 11°54' and 13°07' East.

Phytosociological relevés were laid out in the residual patches of lowland natural vegetation, located in the Province of Rome (Foglino, Nettuno, Padiglione, S. Anastasio) and the Province of Latina (Circeo National Park).

The oak forest grows on flat Pleistocenic dunes ranging in altitude from 10 to 70 m a.s.l.. The morphological depressions of the ancient dunes fill with rainwater in the wet season (piscine) and are characterised by sandy leached soils (Stanisci *et al.*, 1996).

The *Quercus frainetto* and *Q. cerris* forest is located on slightly leached soils of sandy texture. The percentage of clay increases with soil depth and a Bt belt has been identified (Dowgiallo & Bottini, 1998; Dowgiallo & Vannicelli, 1993). Sites from province of Rome are characterised by ancient dunes covered of abundant pyroclastic material coming from Albano Volcanic complex; consequently soils show high percentage of clay.

Regarding the phytoclimate, the sector is included in the Mediterranean region, lower Mesomediterranean thermotype, upper subhumid ombrotype (Blasi, 1994). Mean annual rainfall is 963 mm and the range of mean monthly temperatures is 7-25°C (weather station of Latina).

Data and methods

120 phytosociological relevés according to the Braun-Blanquet (1932) approach: 71 relevés in oak forest; 30 relevés in shrublands; 19 relevés in grasslands.

Binary data were classified and ordered (Podani, 1993) by the chord distance and average linkage methods.

Nomenclature of species follows Anzalone (1994, 1996), and Anzalone *et al.* (1997) for flora of Circeo National Park.

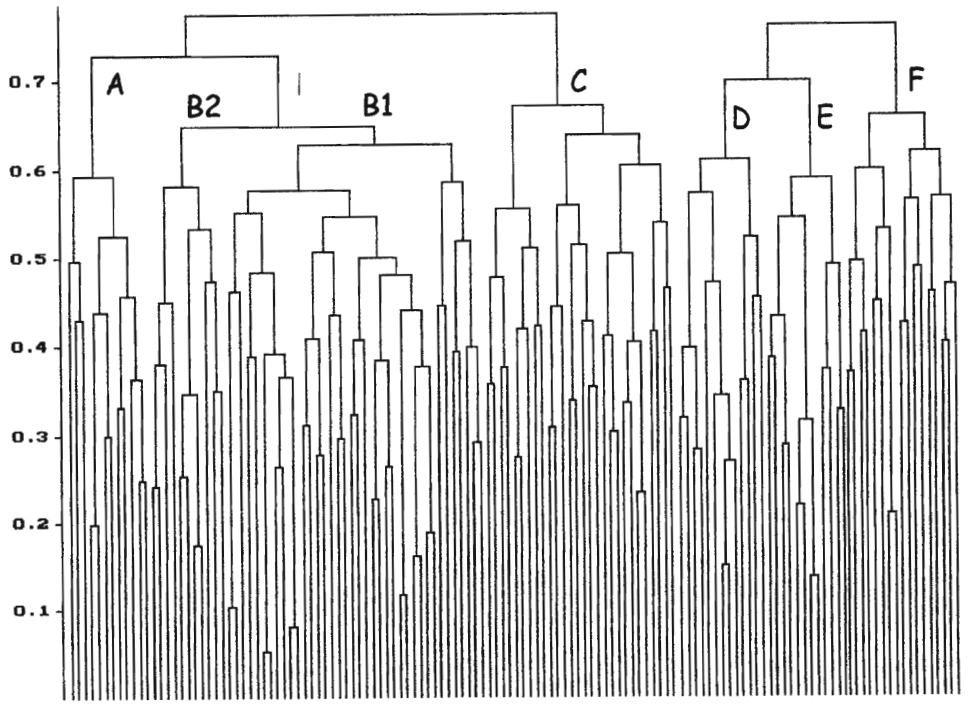
In order to compare our relevés with the relevés of *Echinopo siculi-Quercetum frainetto* from Campania and Molise (Blasi & Paura, 1995), the relevés of *Mespilo germanicae-Quercetum frainetto* from Lazio (Biondi *et al.*, 2001) and the relevés of *Malo florentinae-Quercetum frainetto* from Umbria (Catorci & Orsomando, 1998; Biondi *et al.*, 2001), a synoptic table was drawn up and subjected to classification on binary data by the chord distance and average linkage methods.

For syntaxa quoted in the text the author's name is reported before the bibliographic references.

Site descriptions of original phytosociological relevés are reported in Appendix .

Results

Data classification of the synoptic table (Tab. 1), which includes original and already published relevés of *Quercus frainetto* dominated communities of central



A *Mespilo germanicae-Quercetum frainetto mespiletosum germanicae*: Manziana, Lazio (12 releves); B1 *Mespilo germanicae-Quercetum frainetto arbutetosum unedonis*: Circeo, Lazio (40 releves); B2 *Mespilo germanicae-Quercetum frainetto quercetosum roboris*: Circeo, Lazio (9 releves); C *Mespilo germanicae-Quercetum frainetto cornetosum sanguineae*: Nettuno, Lazio (22 releves); D *Malo florentinae-Quercetum frainetto*: Umbria (12 releves); E *Echinopo siculi-Quercetum frainetto*: Campania (13 releves); F *Echinopo siculi-Quercetum frainetto*: Molise (17 releves)

Fig. 1 - Cluster diagram of the synoptic table of *Quercus frainetto* forest in Thyrrenian Central Italy

and central-southern Italy, showed two main groups (Fig. 1): lowland forests of Lazio, and table-land/hilly forests of Umbria, Molise and Campania.

The main floristic and coenological differences concerned the occurrence of lauriphyllous species (as *Daphne laureola, Ilex aquifolium, Arbutus unedo*) and *Quercetalia ilicis* trasgressive species in southern Lazio oak forests (Fig. 1: A, B, C).

At lower hierarchical level the second group of *Quercus frainetto* forests can be subdivided into 3 types: *Echinopo siculi-Quercetum frainetto* from Molise (Blasi & Paura, 1995); *Echinopo siculi-Quercetum frainetto* from Campania (Blasi & Paura, 1995) and *Malo florentinae-Quercetum frainetto* from Umbria (Catorci & Orsomando, 1998; Biondi *et al.*, 2001) (Fig. 1: D, E, F). The last association showed a strong affinity with the *Echinopo siculi-Quercetum frainetto* and it could represent the northern geographical vicariant of the central-southern association.

On the other hand, the subcoastal *Quercus frainetto* forests of lowland Lazio are clearly linked to *Mespilo germanicae-Quercetum frainetto* (Biondi *et al.*, 2001) even if some floristic and structural differences with the woods coming from Circeo National Park and the woody patches in the Province of Rome can be observed.

The association *Mespilo germanicae-Quercetum frainetto* is strictly linked to deep, leached soils, which guarantee a good water avaibility also during summer; in mesomediterranean Lazio that soil condition occurs in lowland areas and in flat volcanic areas.

The synecology, chorology and coenology of our relevés clearly correspond to the diagnosis of the *Mespilo germanicae-Quercetum frainetto* association; characteristic and differential species are: *Carpinus betulus, Aristolochia rotunda, Mespilus germanica, Daphne laureola, Ilex aquifolium, Vicia grandiflora, Platanthera bifolia.* In our relevés only *Ilex aquilifolium* and *Platanthera bifolia* don't occur, even if they are present in the flora census of sampled sites (Anzalone *et al.*, 1997; Lattanzi *et al.*, in press).

Concerning Lazio subcoastal lowland, three subassociations are recognised according to the different amount of pyroclastic cover and water availability in summer: *arbutetosum unedonis subass.nova, cornetosum sanguineae subass.nova*

and *quercetosum roboris* (Fig. 1; Tab. 1). Coming towards south, pyroclastic cover of ancient dunes becomes less important and the amount of clay in the superficial belt of soils decreases: the understore vegetation is more xeric and many *Quercetalia ilicis* species occur; the new subassociation *arbutetosum unedonis* reveals that synecological condition. On the other hand, residual forest patches in the Province of Rome grow on ancient dunes where pyroclastic cover is more consistent (due to the closeness of Albano Volcanic complex), and more mesophytic species in the herb layer occur. Although these woods have been recently exploited for coppice and horse grazing, their floristic and coenological features clearly correspond to a transition between the subass. *mespiletosum germanicae* on tuff substrate (Biondi *et al.*, 2001) and the subass. *arbutetosum unedonis* on sandy soils; we propose to include them in the new subassociation *cornetosum sanguineae*. Furthermore, along drainage channels and at the edges of moist depressions with *Fraxinus oxycarpa* and *Quercus robur*, the association *Mespilo germanicae-Quercetum frainetto* show more meso-hygrophytic species, which differentiate the subass. *quercetosum roboris* (Biondi *et al.*, 2001).

In the internal gaps of lowland oak forest, mantles with *Cytisus scoparius, Rubus ulmifolius, Daphne gnidium* and many liana as *Rubia peregrina, Asparagus acutifolius* and *Hedera helix* are common.

Concerning syntaxonomy of lowland shrublands and mantles in central Italy, phytosociological studies have only been carried out in the Trasimeno area (Umbria region), where the *Cytisus scoparius* and *Calluna vulgaris* community was referred to the alliance *Pruno-Rubion fruticosi* and the suballiance *Sarothamneion* (Biondi *et al.*, 1995). In Lazio, only in the marly and limestone hills which surround lowland areas, two associations of mantle have been described and included in the alliance *Pruno-Rubion ulmifolii*: *Lonicero etruscae-Rosetum sempervirentis* (Cutini *et al.*, 1996), and *Roso sempervirentis-Rubetum ulmifolii* (Blasi *et al.*, 2000).

The alliance *Pruno-Rubion ulmifolii* describes the Euro-Siberian and south-western Mediterranean thorny shrublands, linked to the oceanic and sub-oceanic bioclimate of hilly and subcoastal belts (De Bolos, 1954; Rivas-Martinez, 1996).

Recently the Italian range and synecology of this alliance has been analysed and a great potentiality for its suballiance *Pruno-Rubenion* pointed out (Blasi *et al.*, 2002). That syntaxon includes deciduous mantles and shrublands in the meso and thermo-mediterreanean bioclimate (Arnaiz & Loidi, 1981; Arnaiz, 1983; Asensi & Rivas-Martinez, 1983).

In Tyrrhenian Italy, the suballiance is linked to geomorphological, pedological and mesoclimatic conditions which guarantee a good level of atmospheric and pedological humidity (Blasi *et al.*, 2002). Furthermore a major penetration of *Pistacio-Rhamnetalia* characteristic species and shrubs with a south-eastern geographical distribution occurs, mainly related to the closeness of the coastline.

Mantles of lowland oak forest in Lazio can be included in the suballiance *Pruno-Rubenion* because their coenological and synecological features clearly correspond to the previous diagnosis.

In the lowland area, besides the characteristic species, some indicator species of leached sandy soils, such as *Cytisus scoparius* and *Daphne gnidium*, occur; furthermore the syndynamic features are quite different from the other associations of the alliance *Pruno-Rubion ulmifolii* in Italy. Consequently a new association of mantle linked to the subcoastal lowland oak forest is proposed: *Daphno gnidii-Cytisetum scopari* ass. nova, with *Cytisus scoparius* and *Daphne gnidium* as characteristic species.

That association shows a thermophytic variant with *Cistus salvifolius* and other Mediterranean macchia species, when spatial contact with cultived land takes place.

In the largest gaps of the subcoastal *Quercus frainetto* forest, where coppice, pasture and fire have been recurrent, *Ericaceae* shrubs and Mediterranean macchia species form a dense shrubland which can be referred to the alliance *Ericion arboreae*, which includes thermo-mesomediterranean *Ericaceae* shrublands on a siliceous substrate linked with the evergreen forests or deciduous oak forests in the Mediterreanean Region (Peinado & Rivas-Martinez, 1987). The original occurrence of the acidophilous *Erica scoparia* together with *Phyllirea latifolia* and *Myrtus communis* allows a new association to be described: *Phillyreo latifoliae-Ericetum scopariae* ass.nova, alliance *Ericion arboreae*, order *Pistacio-Rhamnetalia alaterni*, class *Quercetea ilicis*.

Concerning grassland in the internal gaps of lowland oak forest in Lazio, two main types have been identified: grassland dominated by annual herbs such as *Cynosurus polybracteatus, Moenchia mantica, Tuberaria guttata, Briza maxima* and *Coleostephus myconis,* and the nanotherofitic community of ephemeral small ponds, found in a mosaic pattern with the former grassland only during spring time, and formed by nanotherophytes such as *Juncus bufonius, Juncus capitatus, Juncus pigmeus,*

Tab. 1 - Synoptic table which includes original and already published relevés of Quercus frainetto dominated communities of Thyrrenian Central Italy

Cluster Type	A	B1	B2	C	D	E	F
Releves Number	12	40	9	22	12	13	17
Sites	Manziana	Circeo	Circeo	Nettuno	Umbria	Campania	Molise
Mespilo germanicae- Quercetum frainetto							
Carpinus betulus L.	V	V	V	III	.	I	I
Aristolochia rotunda L.	IV	II	.	III	.	.	I
Mespilus germanica L.	V	IV	II	IV	.	.	I
Vicia grandiflora Scop.	III	II	.	.	.	.	.
subass. mespiletosum germanicae							
Daphne laureola L. ssp. laureola	V	II	I	.	.	.	I
Ilex aquifolium L.	IV	.	.	.	.	.	I
Platanthera bifolia (L.) Rchb.	III	.	.	.	.	.	.
arbutetosum unedonis subass. nova							
Cyclamen hederifolium Aiton	II	V	.	I	II	.	II
Asparagus acutifolius L.	.	IV	II	II	I	II	II
Allium triquetrum L.	.	II	.	.	.	.	.
Arbutus unedo L.	.	II	.	.	.	.	.
subass. quercetosum roboris							
Quercus robur L.	.	I	IV	.	.	.	.
Tilia cordata Miller	.	.	II	.	.	.	.
Populus canescens (Aiton) Sm.	.	.	II	.	.	.	.
cornetosum sanguineae subass. nova							
Cornus sanguinea L.	.	.	.	II	III	.	III
Scutellaria columnae All	III			III		II	I
Calamintha sylvatica Bromf	.	.	.	III	I	.	.
Silene viridiflora L.	.	.	.	II	I	.	.
Malo florentinae-Quercetum frainetto							
Festuca heterophylla Lam.	I	III	II	III	IV	.	II
Hieracium racemosum W. et K.	.	.	.	.	III	.	I
Juniperus communis L.	.	.	.	.	V	.	I
Malus florentina (Zuccagni) Scheider	.	.	.	.	IV	.	I
Quercus crenata Lam	.	.	.	I	II	.	.
Echinopo siculi-Quercetum frainetto							
Cytisus villosus Pourret	.	I	.	I	.	IV	II
Genista tinctoria L.	.	.	.	.	I	IV	III
Echinops siculus Strobl	.	.	.	.	.	IV	II
Teucrio siculi-Quercion cerridis							
Quercus frainetto Ten.	V	V	V	V	V	V	IV
Teucrium siculum Rafin.	I	III	II	IV	IV	V	IV
Oenanthe pimpinelloides L.	II	I	.	I	IV	IV	III
Crepis leontodontoides All.	.	I	.	.	.	I	II
Lathyrus niger (L.) Bernh.	.	.	.	.	V	IV	II
Serratula tinctoria L. ssp. tinctoria	.	I	I	.	.	.	I
Poa sylvicola Guss	.	.	.	I	.	.	I
Lychnis flos-cuculi	.	.	.	.	.	.	I
Serratula tinctoria L.	.	.	.	.	II	.	.
Quercetalia pubescenti-petreae							
Acer campestre L.	V	III	II	III	III	II	III
Fraxinus ornus L.	III	V	V	V	II	V	III
Ligustrum vulgare L.	I	I	II	III	V	I	V
Lithospermum purpurocaeruleum L.	IV	II	I	III	I	I	II
Quercus cerris L.	V	V	IV	V	V	V	V
Sorbus torminalis (L.) Crantz	I	III	III	I	II	III	III
Viola alba Besser	IV	III	III	II	IV	V	V
Stachys officinalis Trevisan	II	I	.	IV	V	V	III
Carpinus orientalis Miller	.	I	I	I	.	V	IV
Pyrus pyraster Burgsd.	.	I	.	.	II	V	III
Clinopodium vulgare L.	I	.	.	II	IV	II	III
Potentilla micrantha Ramond	III	.	.	I	II	II	II
Cornus mas L.	V	.	.	I	I	.	I
Hieracium sylvaticum (L.) L	II	.	.	.	II	.	I
Digitalis micrantha Roth	.	.	.	.	I	.	II
Helleborus foetidus L.	.	.	.	.	I	.	II
Melittis melissophyllum L.	I	.	.	.	.	IV	.
Ostrya carpinifolia Scop.	.	.	.	.	I	I	.
Quercus pubescens Willd	.	.	.	I	.	.	I
Acer monspessulanum L.	I	.	.	.	.	.	.
Hypericum montanum L.	.	.	.	.	II	.	.
Viola suavis Bieb.	.	.	.	.	.	.	I

Querco roboris-Fagetea sylvaticae							
Ajuga reptans L.	III	III	.	IV	IV	I	III
Brachypodium sylvaticum Beauv	III	V	IV	III	IV	II	V
Crataegus monogyna Jacq	III	V	III	V	III	V	IV
Euonymus europaeus L.	V	IV	IV	IV	I	I	III
Euphorbia amygdaloides L.	III	II	II	IV	I	III	I
Hedera helix L.	V	V	V	V	V	IV	III
Lathyrus venetus (Miller) Wohlf	III	IV	III	II	II	IV	II
Luzula forsteri DC	III	V	IV	III	IV	III	IV
Malus sylvestris Miller	III	V	III	II	I	II	I
Prunus spinosa L.	III	II	.	III	V	III	IV
Sorbus domestica L.	III	II	I	II	V	IV	IV
Tamus communis L.	IV	II	I	I	II	II	IV
Melica uniflora Retz.	IV	V	V	I	II	II	.
Ranunculus lanuginosus L.	III	II	.	I	.	I	I
Rubus ulmifolius Schott	V	V	IV	V	III	.	I
Viola reichembachiana Jordan	III	I		IV	III	I	I
Lonicera caprifolium L.	IV	III	.	.	II	.	V
Lonicera etrusca Santi	.	.	.	IV	I	IV	I
Ulmus minor Miller	.	I	I	I	I	.	II
Crataegus oxyacantha L.	V	.	.	.	V	II	II
Geum urbanum L.	II	.	.	II	I	.	II
Prunella vulgaris L.	I	.	.	I	.	I	I
Rosa arvensis Hudson	IV	.	.	I	V	.	I
Luzula campestris (L.) DC	.	.	.	I	I	.	I
Cruciata glabra (L.) Ehrend	.	.	.	II	V	.	I
Cytisus scoparius (L.) Link	II	.	.	II	III	.	.
Moehringia trinervia (L.) Clairv.	I	I	.	.	.	.	.
Primula vulgaris Hudson	I	.	.	.	.	III	I
Sedum cepaea L.	II	.	.	I	.	.	I
Silene italica (L.) Pers.	.	.	.	.	I	I	I
Geranium robertianum L.	.	II	.	I	.	.	.
Asperula laevigata L.	III	.	.	.	.	.	II
Pyrus communis	II	.	.	.	.	.	II
Cephalanthera damasonium (Miller) Druce	.	.	.	.	I	.	I
Coronilla emerus L.	.	.	.	.	II	.	I
Fraxinus oxycarpa Bieb.	.	.	.	I	.	.	I
Lonicera xylosteum L.	I	.	.	.	II	.	.
Malus domestica Borkh	.	.	.	I	.	.	I
Prunus avium L.	.	.	.	.	III	.	III
Rosa canina L.	.	.	.	.	I	.	IV
Sanicula europaea L.	I	.	.	.	.	I	.
Vinca minor L.	.	.	.	I	I	.	.
Populus tremula L.	.	I	.	I	.	.	.
Agrostis tenuis Sibth.	.	.	.	.	I	.	.
Anemone apennina L.	.	.	.	.	.	I	.
Aremonia agrimonioides (L.) DC.	.	.	.	.	.	.	I
Asarum europaeum L.	.	.	.	.	.	.	I
Campanula trachelium L.	.	.	.	.	.	.	I
Cardamine impatiens L.	I	.	.	.	.	.	.
Carex sylvatica Hudson	.	.	.	I	.	.	.
Castanea sativa Miller	.	.	.	.	.	I	.
Cephalanthera longifolia (Hudson) Frittsch	I	.	.	.	.	.	.
Circaea lutetiana L.	I	.	.	.	.	.	.
Galium laevigatum L.	.	.	.	.	.	I	.
Neottia nidus-avis (L.) L. C. Rch.	I	.	.	.	.	.	.
Platanthera chlorantha (Custer) Rchb.	.	.	.	.	II	.	.
Poa nemoralis L.	.	.	.	.	.	.	I
Ptilostemon strictus (Ten.) Greuter	.	.	.	.	I	.	.
Pulmonaria saccharata Miller	.	.	.	.	.	.	I
Rhamnus catharticus L.	.	.	.	.	.	.	I
Solidago virgaurea L.	.	.	.	.	II	.	.
Stachys sylvatica L.	.	.	.	I	.	.	.
Symphytum tuberosum L.	II	.	.	.	.	.	.
Veronica montana L.	I	.	.	.	.	.	.
Viola odorata L.	.	I	.	.	.	.	.
Viola riviniana Rchb.	.	.	.	.	II	.	.
Species from Quercetea ilicis							
Rubia peregrina L.	IV	V	V	II	I	II	I
Ruscus aculeatus L.	V	V	V	V	IV	V	IV
Rosa sempervirens L.	II	III	.	IV	II	V	II
Cyclamen repandum Sm.	II	.	I	.	II	I	I
Smilax aspera L.	.	II	I	I	.	II	I
Erica arborea L.	.	I	.	I	III	V	.
Lonicera etrusca Santi	.	.	.	IV	I	IV	I
Osyris alba L.	.	I	.	.	II	.	I
Carex olbiensis Jordan	.	I	.	.	.	.	I
Carex distachya Desf	.	I	.	I	.	.	.
Cistus salvifolius L.	.	I	.	I	.	.	.
Clematis vitalba L.	.	.	.	I	.	.	I
Melica arrecta Kuntze	.	I	.	I	.	.	.
Phillyrea angustifolia L.	.	I	.	I	.	.	.
Phillyrea latifolia L.	.	.	.	I	.	.	I
Carex distachya Desf	.	I	.	I	.	.	.
Asplenium onopteris L.	.	.	.	I	.	.	.

Clematis flammula L.	.	.	.	II	.	.	.
Laurus nobilis L.	.	.	.	I	.	.	.
Lonicera implexa Aiton	.	.	III	.	.	.	.
Myrtus communis L.	.	I	.	.	.	.	.
Quercus ilex L.	.	II	.	.	.	.	.
Viburnum tinus L. ssp. tinus	.	I	.	.	.	.	.
Other species							
Dactylis glomerata L.	IV	I	I	I	I	III	IV
Fragaria vesca L.	I	II	.	III	IV	II	III
Carex flacca Schrank	.	I	.	III	V	II	I
Pteridium aquilinum L.	III	V	IV	IV	II	.	.
Agrimonia eupatoria L.	I	.	.	III	I	III	II
Cruciata laevipes Opiz	.	I	.	II	II	.	II
Teucrium chamaedrys L.	.	I	.	II	I	I	.
Brachypodium rupestre (Host) Roem. et Schult.	.	I	.	.	III	.	III
Arum italicum Miller	II	.	.	III	.	.	I
Galium aparine L.	II	I	.	.	.	.	I
Stellaria media (L.) Vill	II	I	.	I	.	.	.

SPORADIC SPECIES

Cluster Type A: Pyrus communis II; Aegopodium podagraria L. II; Cherophyllum temulum L. II; Galium album Miller III

Cluster Type B1: Agrostis stolonifera L. I; Asphodelus microcarpus Viv II; Brachypodium rupestre (Host) Roem. et Schult. I; Carduus pycnocephalus L. ssp. pycnocephalus I; Carex depauperata Curtis ex With. I; Carex flacca Schrank I; Centaurium erythraea Rafn ssp. erythraea I; Cruciata laevipes Opiz I; Dactylis glomerata L. I; Fragaria vesca L. II; Galium aparine L. I; Geranium purpureum Vill. I; Lamium bifidum Cyr. I; Ornithopus compressus L. I; Pinus pinea L. I; Polypodium cambricum L. ssp. serrulatum (Sch. ex Arc.) Pic. Ser. I; Pteridium aquilinum L. V; Ranunculus ficaria L. ssp. ficaria I; Rumex acetosa L. I; Sonchus oleraceus L. I; Stellaria media (L.) Vill I; Teucrium chamaedrys L. I; Vicia hirsuta (L.) S. F. Gray I; Vicia loiseleurii (MB.) Litv. I;

Cluster Type B2: Dactylis glomerata L. I; Geranium purpureum Vill. I; Pteridium aquilinum L. IV; Sonchus maritimus L. ssp maritimus I;

Cluster Type C: Agrimonia eupatoria L. III; Alliaria petiolata Cavara et Grande I; Arum italicum Miller III; Asphodelus microcarpus Viv II; Carex caryophyllea I; Carex divulsa I; Carex flacca Schrank III; Cruciata laevipes Opiz II; Dactylis glomerata L. I; Dactylis hispanica Roth I; Danthonia decubens (L.) DC I; Erica scoparia L. I; Euphorbia pubescens Vahl I; Fragaria vesca L. III; Holcus lanatus L. I; Hypericum australe Ten I; Hypericum perfoliatum L. I; Lapsana communis L. I; Lychnis coronaria (L.) Desr I; Myosotis arvensis L. I; Myosotis sicula I; Orobanche hederae Duby I; Pteridium aquilinum L. IV; Pulicaria odora (L.) Rchb I; Rumex acetosa L. I; Rumex sanguineus L. I; Stellaria media (L.) Vill I; Teucrium chamaedrys L. II;

Cluster Type D: Inula conyza DC I; Centaurea bracteata Scop. I; Geranium sanguineum I; Juniperus oxycedrus L. I; Pyracantha coccinea Roemer I; Rosa gallica L. I; Veronica officinalis L. I;

Cluster Type E: Anthoxantum odoratum L. I; Aristolochia pallida Willd. III; Asplenium adiantum-nigrum L. II; Dorycnium pentaphyllum Scop. III; Festuca drymeia M. et K.* V ; Helianthemum nummularium (L.) Miller I; Hieracium sp. IV; Polygala sp. I; Pulicaria odora (L.) Rchb III; Rubus sp. IV; Teucrium montanum L. I; Trifolium ochroleucum Hudson I; Trifolium pratense L. I; Veronica chamaedrys III;

Cluster Type F: Acer neapolitanum L. I; Achillea millefolium L. I; Allium pendulinum I; Anthoxantum odoratum L. I; Bellis perennis L. I; Cytisus sessilifolius L. I; Dactylis hispanica Roth I; Festuca circummediterranea Patzke I; Festuca drymeia M. et K.* I; Geranium asphodeloides Burm. I; Geranium brutium Gasparr. I; Hypericum hirsutum L. I; Inula conyza DC I; Lathyrus aphaca L. I; Lathyrus sphaericus Retz. I; Leopoldia comosa (L.) Parl. I; Ornithopus compressus L. I; Poa bulbosa L. I; Prunella grandiflora (L.) Scholler I; Prunus cerasifera Ehrh. I; Prunus cerasus L. I; Ptilostemon strictus (Ten.) Greuter III; Pyrus communis II; Ranunculus bulbosus sub. aleae L. I; Ranunculus ficaria L. ssp. ficaria I; Ranunculus nemorosus DC: I; Rosa micrantha SM. I; Rubus candicans Weihe I; Rubus sp. IV; Stellaria holostea L. I; Stipa bromoides (L.) Dorfl I; Trifolium ochroleucum Hudson I; Trifolium pratense L. I; Veronica chamaedrys I; Veronica officinalis L. I; Vicia sepium L. I; Vicia sativa L. I

Isolepis cernua, Cicendia filiformis, Silene laeta and *Radiola linoides* .

The first community was included in the *Moenchio-Tuberarietum guttatae* association, already described for soils rich in siliceous sand of the subcoastal area of Lazio (Lucchese & Pignatti, 1987); it belongs to the alliance *Heliantemion guttati,* order *Heliantemetalia guttati*, class *Heliantemetea guttati.*

The second community, which occupies small clay ponds where rainwater can remain between February and April, shows several rare or less common species and can be included in a new Mediterranean-Atlantic association: *Sileno laetae-Isolepetum cernuae ass. nova,* belonging to the alliance *Cicendio-Solenopsion laurentiae*, order *Isoetetalia* , class *Isoeto-Nanojuncetea* (Brullo & Minissale, 1998*).*

A detailed structural and coenological description for each successional stage of the lowland oak forest series in Lazio is as follows.

MESPILO GERMANICAE-QUERCETUM FRAINETTO Biondi, Gigante, Pignatelli & Venanzoni 2001

ARBUTETOSUM UNEDONIS subass. nova (*Holotypus*: Tab. 2, rel. 19)

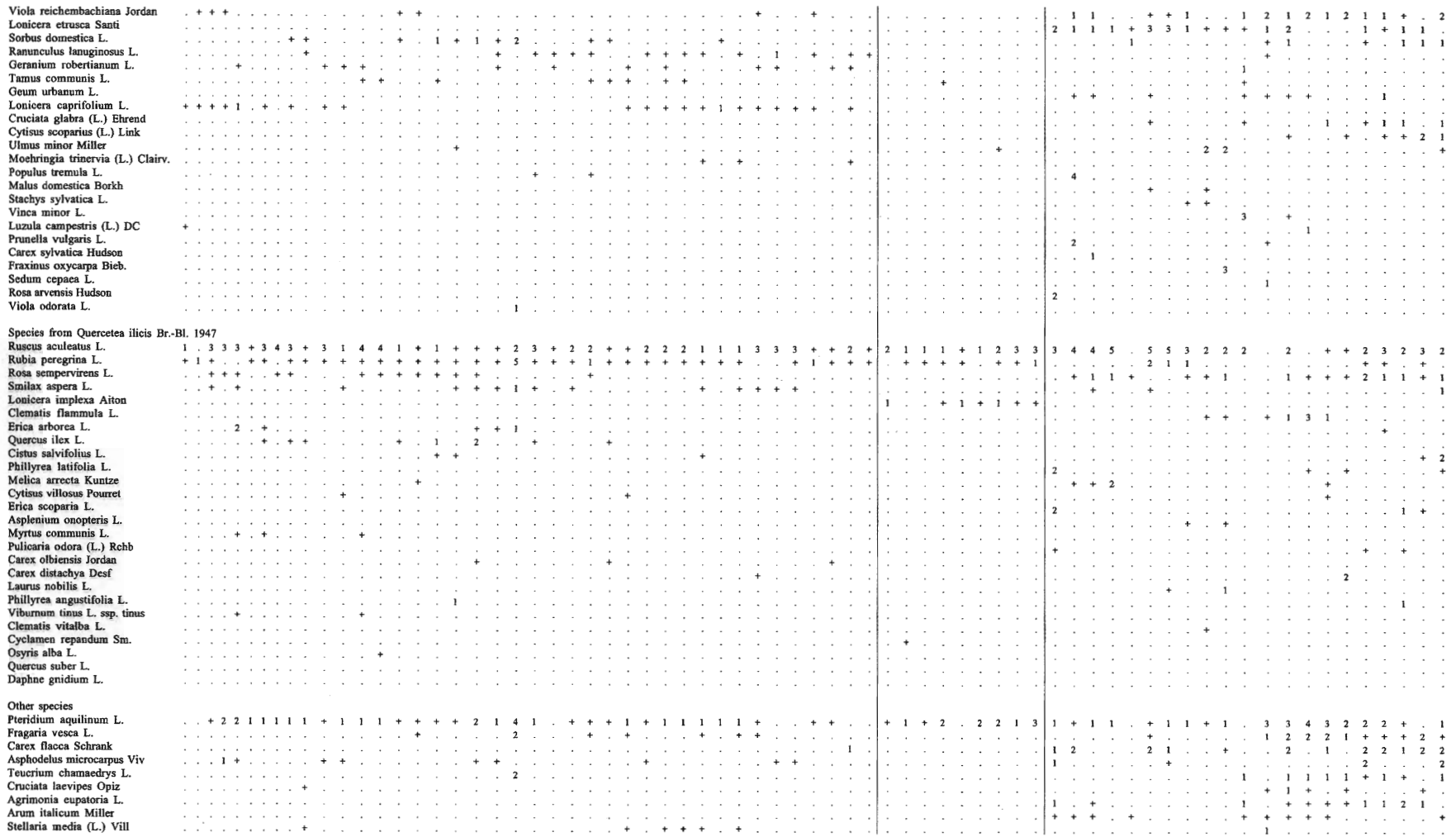
CORNETOSUM SANGUINAE subass. nova (*Holotypus*: Tab. 2, rel. 61)

QUERCETOSUM ROBORIS Biondi, Gigante, Pignatelli & Venanzoni 2001

PHYSIOGNOMY: multi-stratified forest where *Quercus cerris* and *Q. frainetto* prevail in the high tree layer (mean height 20 m, mean cover 85%), even if *Quercus robur* can locally reach high cover value, whereas *Fraxinus ornus, Carpinus betulus, Acer campestre* are common in the low tree layer (mean height 12 m, mean cover 60%). The other layers are shrub, herbaceous and liana with variable cover percentages (see Appendix).

SYNECOLOGY AND DISTRIBUTION: the new subassociation *arbutetosum unedonis* includes *Quercus frainetto* forest on leached sandy soils of lowlands in meso-

Tab. 2 - *Mespilo germanicae- Quercetum frainetto arbutetosum unedonis* subass. nova, *cornetosum sanguineae* subass. nova, subass. *quercetosum roboris*



Sporadic species: R1 Geranium purpureum Vill. +; R5 Ornithopus compressus L. +; R6 Pinus pinea L. +, Vicia hirsuta (L.) S. F. Gray +; R7 Brachypodium rupestre (Host) Roem. et Schult. +, Rumex acetosa L. +; R8 Dactylis glomerata L. 1; R14 Geranium purpureum Vill. +; R20 Carduus pycnocephalus L. ssp. pycnocephalus +; R22 Polypodium cambricum L. ssp. serrulatum (Sch. ex Arc.) Pic. Ser. +; R23 Sonchus oleraceus L. +, Vicia loiseleurii (MB.) Litv. +; R24 Lamium bifidum Cyr. +; R26 Pinus pinea L. +; R30 Geranium purpureum Vill. +; R34 Brachypodium rupestre (Host) Roem. et Schult. +, Rumex acetosa L. +,Vicia loiseleurii (MB.) Litv. +; R37 Agrostis stolonifera L. +; Vicia loiseleurii (MB.) Litv. +; R38 Carex depauperata Curtis ex With. +, Vicia hirsuta (L.) S. F. Gray +,Vicia loiseleurii (MB.) Litv. +; R39 Galium aparine L. +, Sonchus oleraceus L. +, Vicia loiseleurii (MB.)Litv. +; R40 Geranium purpureum Vill. +; R61 Dactylis glomerata L. +; R48 Sonchus maritimus L. ssp maritimus +. R50 Carex caryophyllea La Tourr. 1, Rumex acetosa L. +; R51 Myosotis sicula Guss 2, Carex divulsa Stokes +, Rumex sanguineus L. +; R52 Lapsana communis L. +; R55 Dactylis glomerata L. +; R57 Orobanche hederae Duby 3; R58 Alliaria petiolata Cavara et Grande 1, Orobanche hederae Duby +; R59 Alliaria petiolata Cavara et Grande 1, Orobanche hederae Duby +; R60 Myosotis arvensis L.+; R61 Alliaria petiolata Cavara et Grande 1, Myosotis arvensis L. 1, Lapsana communis L. +, Rumex sanguineus L. +; R64 Hypericum perfoliatum L. 1, Lychnis coronaria (L.) Desr 1; R65 Hypericum perfoliatum L. 1; R66 Dactylis glomerata L. +; R68 Holcus lanatus L. 2, Dactylis hispanica Roth +, Rumex acetosa L. +; R69 Holcus lanatus L. +, Dactylis glomerata Roth +.

Mediterranean climate. This forest includes broadleaf and lauriphyllous species because of soil structure (thick belt B) and the proximity of the water table which guarantee water availability in summer. Even if *Quercetalia pubescentis* species are the most common plants, *Fagetalia sylvaticae* and *Quercetalia ilicis* species also occur.

On the other hand, the new subassociation *cornetosum sanguinae* includes *Quercus frainetto* forest in meso-Mediterranean climate, on leached sandy soils enriched with pyroclastic material coming from the close Albano volcanic complex. Many mesophytic herb and shrub species belonging to *Quercetalia pubescentis* and *Fagetalia sylvaticae* orders occur. It represents the transition community between the internal subass. *mespiletosum germanicae* (Biondi *et al.*, 2001) and the southern subass. *arbutetosum unedonis*.

Along drainage channels and at the edges of moist depressions the subass. *quercetosum roboris* (Biondi *et al.*, 2001) with *Quercus robur*, *Populus canescens* and *Tilia cordata* can be found. It occupies a transitional position between the main forest of the lowland and the hygromesophytic wood of the *Veronico scutellatae-Quercetum roboris* association (Fig. 3).

CHARACTERISTIC AND DIFFERENTIAL SPECIES: the characteristic species of association *Carpinus betulus, Aristolochia rotunda, Mespilus germanica, Daphne laureola, Vicia grandiflora* occur. Differential species of *arbutetosum unedonis* subass. nova are *Arbutus unedus, Cyclamen hederifolium, Asparagus acutifolius, Allium triquetrum*. Differential species of *cornetosum sanguineae* subass. nova are *Cornus sanguinea, Calamintha sylvatica, Scutellaria columnae, Silene viridiflora*. Differential species of *quercetosum roboris* are *Quercus robur, Tilia cordata, Populus canescens*; the differential species pool is slightly changed from the original proposal because *Allium triquetrum* and *Ranunculus ficaria*, which were first considered differential species (Biondi *et al.*, 2001) are more common in the subass. *arbutetosum unedonis*.

DYNAMICS: the subass. *arbutetosum unedonis* and the subass. *cornetosum sanguinae* make serial contacts (Fig. 2) with the shrubby mantle belonging to *Daphno gnidii-Cytisetum scopariae* and with the *Phillyreo latifoliae-Ericetum scopariae* association, which includes shrubland in old deeply grazed stands. Furthermore, successional links occur with the secondary grassland *Moenchio-Tuberarietum guttatae*.

Concerning the subass. *quercetosum roboris*, only serial contact with grasslands of *Agropyro-Rumicion* alliance were observed.

Close to the wet interdunal depressions, *Mespilo germanicae-Quercetum frainetto* subass. *arbutetosum unedonis* and subass. *cornetosum sanguinae* make catenal contact with the hygromesophytic wood with *Quercus robur* and *Fraxinus angustifolia* subsp. *oxycarpa*, classified in the *Veronico scutellatae-Quercetum roboris* (*Populion albae*) association (Stanisci *et al.*, 1998). On the other hand, where the table land is just higher and loose sand soils occur, the new subassociations make catenal contact with the more xerophitic *Quercetum frainetto-suberis* association (Blasi *et al.*, 1997) (Fig. 3).

VARIABILITY: the floristic and structural composition may be variable inside the three subassociations because of the different forest management and anthropic-zoogene

1- *Mespilo germaniacae-Quercetum frainetto arbutetosum unedonis* and *cornetosum sanguineae*; 2- *Daphno gnidii-Cytisetum scopariae*; 3- *Phillyreo latifoliae-Ericetum scopariae*; 4- *Moenchio-Tuberarietum guttatae*; 5- *Sileno laetae-Isolepetum cernuae*

Fig. 2 - Lowland serie of *Mespilo germanicae-Quercetum frainetto*

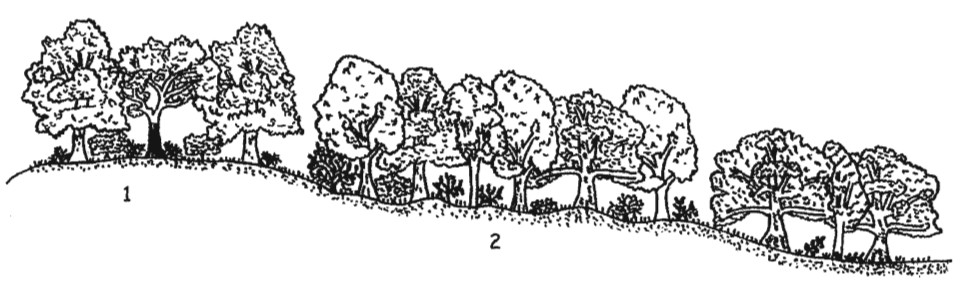
disturbance during the last few decades (e.g wild boars grazing in Circeo National Park and recent coppicing in Foglino and Nettuno).

Furthermore, it is worth noting that the last large-scale drainage of the table land caused some floristic and coenological modifications as recorded by Anzalone *et al.* (1997), comparing the flora census carried out before the hydrological transformations by Beguinot (1935): several meso-hygrophytic species become rare or have disappeared in lowland landscape because of lowering of the water table. So although the recent residual patches of lowland oak forest have an important documentary role, their floristic composition has changed from that of the primeval oak forest, because of several different types of disturbance that have occurred.

DAPHNO GNIDII-CYTISETUM SCOPARIAE ass. nova
(*Holotypus*: Tab. 3, rel. 5)
PHYSIOGNOMY: this scrub (mean height 3 m, mean cover 80%) with *Rubus ulmifolius, Euonymus europaeus, Ligustrum vulgare, Prunus spinosa, Crataegus monogyna, Mespilus germanica* and *Cytisus scoparius* has a liana layer rich in *Hedera helix, Rubia peregrina* and *Asparagus acutifolius*.
SYNECOLOGY AND DISTRIBUTION: the new association identifies the mantle inside of the internal gaps of the lowland oak forest in the subcoastal area of central Tyrrhenian Italy. The thick scrub includes several deciduous subacidophilous shrubs and many liana.
CHARACTERISTIC SPECIES: *Daphne gnidium* and *Cytisus scoparius.*
VARIABILITY: along the edges of tracks and cultivated fields, a thermophytic variant with *Cistus salvifolius* and *Rosa sempervirens* can be recognized.

PHILLYREO LATIFOLIAE-ERICETUM SCOPARIAE ass. nova
(*Holotypus*: Tab. 4, rel. 7)
PHYSIOGNOMY: the shrubland (mean height 3 m, mean cover 90%) with *Erica scoparia, Juniperus communis, Myrtus communis* and *Phillyrea latifolia* has a liana layer rich in *Hedera helix, Rubia peregrina, Smilax aspera* and *Asparagus acutifolius*, and a herb layer (mean cover 10%) with *Ruscus aculeatus* and *Pulicaria odora.*
SYNECOLOGY AND DISTRIBUTION: it occupies the areas where grazing and coppicing were intense until the Fifties; here the leached sandy soils are characterised by a thin belt A (25 cm) and a thick belt B (Dowgiallo & Bottini, 1998). It is worth noting that *Erica scoparia* reaches in central Italy the south-eastern boundary of its geographic distribution and it only occurs where water availability during summer is guaranteed (Pignatti, 1982; Braun-Blanquet, 1979).
CHARACTERISTIC SPECIES: *Erica scoparia, Juniperus communis* and *Pulicaria odora.*

MOENCHIO-TUBERARIETUM GUTTATAE Lucchese et Pignatti 1987 (Tab. 5)
PHYSIOGNOMY: grassland where annual plants are dominant; *Cynosurus polybracteatus, Moenchia mantica, Briza maxima, Coleostephus myconis, Anthoxantum odoratum* are the most common species.
SYNECOLOGY AND DISTRIBUTION: it can be found in the large internal gaps of the lowland oak forest, where moderate grazing and trampling take place. Therophytes are dominant (mean cover 65 %) but perennial herbs also occur. The association is widespread in subcostal area of central Tyrrhenian Italy.
CHARACTERISTIC SPECIES: *Cynosurus polybracteatus,*



1- *Quercetum frainetto-suberis*; 2- *Mespilo germaniacae-Quercetum frainetto arbutetosum unedonis* and *cornetosum sanguineae*; 3- *Veronico scutellatae-Quercetum roboris*

Fig. 3 - Catenal contacts of lowland *Mespilo germanicae-Quercetum frainetto*

Tab. 3 - *Daphno gnidii-Cytisetum scopariae* ass. nova

Releve Number	1	2	3	4	5*	6	7	8	9	10	11	12	13
Daphno gnidii-Cytisetum scopariae ass.nova													
Cytisus scoparius (L.) Link	3	2	3	1	2	2	.	2	.	2	2	.	.
Daphne gnidium L.	.	.	2	.	+	.	2	2	+	1	3	2	1
Cistus salvifolius variant													
Cistus salvifolius L.	.	1	1	.	.	.	.	.	2	2	2	2	3
Pruno-Rubion ulmifolii de Bolos (1954) 1962													
Rubus ulmifolius Schott	2	4	4	5	3	4	4	4	2	2	1	5	2
Rubia peregrina L.	.	1	1	+	+	2	1	.	1	2	.	.	.
Euonymus europaeus L.	+	.	.	.	+	2	+	+	.	.	.	.	.
Pruno-Rubenion Arnaiz et Loidi 1983													
Asparagus acutifolius L.	.	+	+	.	1	1	1	1	1	1	.	.	1
Myrtus communis L.	.	1	1	1	.	+	.	+	+	.	.	.	.
Phillyrea latifolia L.	.	.	1	.	.	.	.	.	.	.	4	3	.
Smilax aspera L.	.	.	.	.	.	.	.	+	.	2	.	.	.
Prunetalia spinosae Tx. 1952													
Rhamno-Prunetea spinosae R. Goday B. Carbonell 1961													
Prunus spinosa L.	4	.	.	.	1	+	.	.	.	3	2	2	4
Crataegus monogyna Jacq	.	.	.	.	3	.	+	+	.	.	1	1	1
Pteridium aquilinum L.	.	.	1	1	.	.	1	.	.	.	.	.	.
Acer campestre L.	.	.	.	1	.	.	.	.	.	1	.	.	.
Ligustrum vulgare L.	.	.	.	.	.	.	.	.	4	3	.	.	.
Malus sylvestris Miller	.	.	.	1	+	.	.	.	.	.	.	.	.
Pyrus pyraster Burgsd	.	.	.	.	.	.	.	.	.	.	.	.	1
Sorbus torminalis (L.) Crantz	.	.	.	.	.	+	.	.	.	.	.	.	.
Ulmus minor Miller	1	.	.	.	.	.	.	.	.	.	.	.	.
Species from Quercetea ilicis Br.-Bl. 1947													
Ruscus aculeatus L.	.	.	.	+	1	1	+	+	.	.	.	+	.
Rosa sempervirens L.	.	.	.	.	.	.	.	.	2	1	1	.	.
Arbutus unedo L.	.	.	.	.	+	+	.	.	.	.	.	.	.
Erica arborea L.	.	.	.	.	.	.	+	.	.	.	.	.	.
Phillyrea angustifolia L.	.	.	.	.	.	.	.	.	1	.	.	.	.
Other species													
Brachypodium sylvaticum Beauv	+	.	+	1	+	+	1	.	1	+	.	.	.
Hedera helix L.	.	.	+	2	4	4	4	4	.	1	.	.	.
Carex flacca Schrank	.	2	1	.	.	.	.	.	.	.	1	1	1
Fraxinus ornus L.	.	1	+	+	+	2	2	1	.	.	.	.	.
Quercus cerris L.	+	.	1	+	+	1	.	.	1	.	+	.	.
Mespilus germanica L.	.	.	.	.	3	2	+	.	.	.	.	.	.
Briza maxima L.	.	.	1	.	.	.	.	.	.	.	.	.	.
Daphne laureola L.	.	.	.	+	+	.	.	+	.	.	.	.	.
Quercus frainetto Ten.	1	.	.	.	.	.	.	.	+	.	.	.	.
Aristolochia rotunda L.	.	.	.	+	.	.	.	.	1	.	.	.	.
Asphodelus microcarpus Viv	.	.	+	.	.	.	.	.	.	.	.	.	.
Fragaria vesca L.	.	.	.	+	+	.	.	.	.	.	.	.	.
Teucrium siculum Rafin.	.	.	.	+	.	.	+	.	.	.	.	.	.
Euphorbia amygdaloides L.	.	.	.	.	.	.	1	.	.	.	.	.	.
Geranium robertianum L.	.	.	.	.	+	.	.	.	.	.	.	.	.
Silene alba Krause	+	.	.	.	.	.	.	.	.	.	.	.	.
Stachys officinalis Trevisan	.	.	.	.	.	.	.	.	.	.	.	+	.

Moenchia mantica, Lotus angustissimus, Anagallis parviflora, Aira elegans, Trifolium ligusticum.

VARIABILITY: the species cover can show an appreciable variation year by year in relation to grazing and trampling intensity.

SILENO LAETAE-ISOLEPETUM CERNUAE ass. nova (*Holotypus*: Tab. 6, rel. 6)

PHYSIOGNOMY: microcommunity dominated by annual *Juncus sp.pl.* (e.g *Juncus bufonius, J. capitatus, J. pygmeus*).

SYNECOLOGY AND DISTRIBUTION: it occupies the small wet depressions in the *Moenchio-Tuberarietum guttatae* grassland; it only appears during spring time, after winter and early spring rainfall, which causes the temporary occurrence of small clay ponds. Some rare species as *Isoetes velata, Lythrum borysthenicum, Apium crassipes* e and *Silene laeta* are closely linked to that micro-habitat (Lattanzi *et al.* in press).

CHARACTERISTIC SPECIES: *Isolepis cernua, Silene laeta, Isoetis histrix, I. velata.*

Tab. 4 - *Phillyreo latifoliae-Ericetum scopariae* ass. nova

Rleves Number	1	2	3	4	5	6	7*	8	9	10	11	12	13	14	15	16	17
Phyllireo latifoliae-Ericetum scopariae ass.nova																	
Erica scoparia L.	4	5	3	5	5	5	5	4	5	5	5	3	5	4	5	3	5
Pulicaria odora (L.) Rchb	2	1	+	.	.	.	+	+	+	+	+	.	+	2	.	.	.
Juniperus communis L.	.	+	1	.	+	2	1	1	1	.	.	.	.	.	.	.	.
Ericion arboreae Rivas-Martinez 1987 Pistacio lentisci-Rhamnetalia alaterni Rivas-Martinez 1975																	
Myrtus communis L.	.	2	2	2	2	1	2	1	1	1	2	3	+	.	.	.	.
Daphne gnidium L.	.	.	.	+	+	.	.	.	.	.	.	1	2	+	.	.	.
Melica arrecta Kuntze	.	.	+	.	.	.	+	.	+	+	+	.	.	.	.	.	.
Rhamnus alaternus L.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.
Erica arborea L.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.
Arbutus unedo L.	.	.	.	.	+	.	1	1	.	.	.	.	.	.	.	.	.
Quercetea ilicis Br.-Bl. 1947																	
Phillyrea latifolia L.	3	2	3	2	2	+	1	2	+	+	1	2	2	2	2	.	.
Ruscus aculeatus L.	.	+	.	.	.	+	+	+	1	1	+	.	1	1	2	4	2
Rubia peregrina L.	.	+	.	+	.	.	.	+	+	.	.	1	.	.	.	1	.
Smilax aspera L.	.	+	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.
Asparagus acutifolius L.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.
Lonicera etrusca Santi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.
Carex hallerana Asso	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.
Phillyrea angustifolia L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	3
Lonicera implexa Aiton	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Species from Rhamno-Prunetea spinosae R.Goday B. Carbonell.1961																	
Hedera helix L.	.	.	.	.	.	.	+	+	1	+	+	.	.	.	+	.	.
Rubus ulmifolius Schott	.	.	.	.	+	.	.	+	+	.	.	.	+	.	1	.	.
Cytisus scoparius (L.) Link	.	.	.	1	.	.	.	+	.	.	+	1	2	.	1	+	.
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 et Theurillat 1984, Querco roboris-Fagetea sylvaticae Br.-Bl. et Vlieg. 1937 em. Oberd. 1992																	
Quercus frainetto Ten.	.	.	+	.	.	.	1	1	2	2	1	1	+	3	3	2	2
Quercus cerris L.	.	.	+	.	1	2	.	.	.	1	+	1	3	2	3	4	3
Fraxinus ornus L.	.	1	1	.	.	+	+	+	1	2	+	.	.	.	.	.	.
Stachys officinalis Trevisan	1	.	1	.	.	+	.	.	1	.	.	.	.	1	.	.	+
Brachypodium sylvaticum Beauv	+	+	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
Festuca heterophylla Lam.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	2
Ajuga reptans L.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Teucrium siculum Rafin.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Other species																	
Carex flacca Schrank	1	1	+	.	.	.	.	.	.	.	.	.	1	1	1	1	1
Cistus salvifolius L.	1	.	.	+	.	.	.	.	.	.	.	+	3	+	+	+	+
Oenanthe pimpinelloides L.	.	1	+	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Melica uniflora Retz.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.
Asphodelus microcarpus Viv	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.
Anthoxantum odoratum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Holcus lanatus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Hypericum australe Ten	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.

Conclusions

Past and present human land use has intensely reduced the distribution pattern of Mediterreanean lowland oak-forest, which nowadays only occurs in a few scattered patches. In the Lazio region, the largest residual forests of lowland belong to the Circeo National Park and the Nettuno Foundation, and they represent an important document close to the original natural landscape, even if the last drainage works, wood exploitation and grazing of wild boars have caused some floristic and structural variations also inside the protected lands.

The most mature stage of the lowland forest is now represented by *Quercus frainetto* and *Q. cerris* forest with a lower tree layer dominated by *Carpinus betulus* and *Fraxinus ornus*, referred to *Mespilo germanicae-*

Tab. 5 - *Moenchio-Tuberarietum guttatae* Lucchese et Pignatti 1987

Releves Number	1	2	3	4	5	6	7	8
Moenchio-Tuberarietum guttatae Lucchese, Pignatti 1987								
Cynosurus polybracteatus Poiret	2	2	3	1	3	.	3	2
Moenchia mantica (L.) Bartl	1	1	3	.	.	.	2	2
Lotus angustissimus L.	2	2	1	2	1	+	1	.
Anagallis parviflora Hoffmgg et Link	1	1	1	.	.	.	.	2
Aira elegans Willd	.	+	.	.	.	2	.	.
Trifolium ligusticum Balbis	.	.	.	.	+	.	.	.
Heliantemion guttati Br.-Bl. 1931								
Ornithopus pinnatus (Miller) Druce	+	1	+	+	.	+	1	.
Galium divaricatum Lam	.	.	1	1	.	.	.	.
Oglifa gallica Chrtk et Holub	.	.	.	+	1	.	.	.
Parentucellia viscosa (L.) Caruel	+	.	.	+	.	.	.	1
Heliantemetalia guttati Br.-Bl. 1940								
Coleostephus myconis (L.) Cass	2	2	2	4	2	+	1	2
Briza maxima L.	2	2	1	1	1	+	2	.
Tuberaria guttata (L.) Fourr	1	1	.	1	.	3	4	1
Rumex bucephalophorus L.	.	.	.	.	+	1	2	.
Tolpis umbellata Bertol	.	.	.	.	1	+	.	.
Bellis annua L.	1	+	.	.	.	.	.	1
Cynosurus elegans Defs	.	1	+	.	.	.	.	.
Trifolium glomeratum L.	.	.	.	.	.	+	.	.
Trifolium strictum L.	.	.	.	.	.	.	+	.
Avena barbata Potter	.	.	.	.	.	.	+	.
Vulpia ciliata (Danth) Link	.	.	.	.	.	+	.	.
Heliantemetea guttati Br.-Bl. 1952								
Gaudinia fragilis (L.) Beauv	3	+	+	1	1	2	.	2
Briza minor L.	+	1	.	+	+	+	.	.
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	.	.	.
Euphorbia helioscopia L.	+	.	.	.	.	.	.	.
Species from Brachypodietalia phoenicoidis Br.-Bl. ex Mol. 1935, Festuco-Brometea Br.-Bl. et Tx.1943								
Carex flacca Schrank	1	1	.	2	1	.	.	.
Linum bienne Miller	1	1	.	1	1	.	.	2
Centaurium erythraea RAFN	.	.	.	+	+	.	.	.
Trifolium angustifolium L.	.	.	.	.	+	.	.	.
Species from Isoeto-Nanojuncetea Br.-Bl. & R. Tx. ex Westhoff et al. 1946								
Juncus capitatus Weigl	2	1	+	1	+	.	2	.
Silene laeta (Aiton) Godron	1	1	1	2	2	.	.	.
Hypericum australe Ten	1	1	1	.	.	.	.	+
Ranunculus sardous Crantz	1	.	2	.	.	.	.	2
Laurentia gasparrini (Tineo) Strobl	+	+	.	+	.	.	.	.
Mentha pulegium L.	1	.	.	.	.	.	.	1
Myosotis sicula Guss	2	1	3	.	.	.	.	1
Isoetes histrix Bory	.	.	.	.	1	.	1	.
Radiola linoides Roth	.	2	+	.	.	.	.	.
Centaurium maritimum (L.) Fritsch	.	+	.	.	.	.	.	.
Juncus bufonius L.	.	.	1	.	.	.	.	.
Other species								
Anthoxantum odoratum L.	3	3	1	3	2	+	2	3
Plantago lanceolata L.	1	1	1	+	1	1	.	.
Oenanthe pimpinelloides L.	+	+	1	+	1	.	.	.
Holcus lanatus L.	+	.	1	+	.	+	.	1
Centaurea iacea sot angustifolia L.	+	.	+	+	+	.	.	.
Pulicaria odora (L.) Rchb	+	+	+	.	.	.	.	.
Bromus hordeaceus L.	+	.	.	.	+	.	+	.
Danthonia decubens (L.) DC	.	1	+	.	.	.	.	.
Lythrum junceum Banks et Sol	1	.	+	.	.	.	.	.
Inula viscosa Aiton	.	.	+	.	+	.	.	.
Asphodelus microcarpus Viv	.	.	.	1	.	.	+	.
Euphorbia falcata L.	.	.	.	2	1	.	.	.
Ranunculus flabellatus Desf	.	1	.	.	.	.	+	.
Daucus carota L.	.	.	.	.	.	+	.	.
Agrostis stolonifera L.	.	.	.	.	.	.	+	.
Kickxia commutata (Bernh) Fritsch	.	.	.	.	.	+	.	.
Prunella laciniata L.	.	+	.	.	.	.	.	.
Reichardia picroides (L.) Roth	.	.	.	.	.	.	1	.
Rumex angiocarpus Murb	.	.	.	.	.	.	+	.
Serapias lingua L.	.	.	.	.	.	.	+	.
Euphorbia cuneifolia Guss	.	.	.	.	.	.	.	1

Quercetum frainetto arbutetosum unedonis subass. nova, on leached sandy soils (Province of Latina), and *cornetosum sanguineae,* on sandy soil enriched with pyroclastic material (Province of Rome). The two subassociations are endemic of the Tyrrhenian lowland of central-southern Italy in meso-Mediterreanean climate, and they would have had a wider distribution before the large scale drainage of marshes in the 1940s and exploitation of the reclaimed land for crops and livestock (Béguinot, 1935; Blasi *et al.,* 1995).

About mantles and shrublands of lowland oak forest series, two new associations belonging to the suballiance *Pruno-Rubenion ulmifolii* and the alliance *Ericion arborae* are recognised. Both syntaxa have a south-western European distribution, as also the alliance *Heliantemion guttati* of the secondary grasslands.

It is worth noting that the mature vegetation stages show more affinity to south-eastern European forests (e.g. *Quercion frainetto-cerridis*) whereas the early successional stages tend to have more floristic and coenological affinities with southwestern European vegetation: this contributes to the high coenological biodiversity of the vegetation landscape of Tyrrhenian Italy.

The results of this paper have shown that the structural and floristic composition of the lowland oak forest is often modified by anthropo-zoogenic disturbance, endangering its documentary value. Consequently, the residual forest patches should be preserved allowing the recover of their structural and floristic complexity, and they should be connected each other by an ecological network restoring the ecosystem integrity. On the other hand, the traditional land use of lowlands (such as moderate grazing and extensive cultivation) could be encouraged allowing the occurrence of some forest gaps which maintain the present high floristic and landscape biodiversity, thus enabling endemic mantles, shrublands and grassland communities to survive.

Tab. 6 - *Sileno laetae-Isolepetum cernuae* ass. nova

Releves Number	1	2	3	4	5	6*	7	8	9	10	11
Sileno laetae-Isolepetum cernua ass.nova											
Isolepis cernua (Vahl) R et S	.	1	.	1	2	+	.	.	+	.	+
Silene laeta (Aiton) Godron	.	+	+	.	.	+	.	1	+	.	.
Isoetes histrix Boby	2	2	2	1	+	+	.	.	.	.	.
Isoetes velata A Braun	.	.	.	.	.	.	3	+	2	3	3
Cicendio-Solenopsion laurentiae Brullo & Minissale 1998											
Anagallis parviflora Hoffmgg et Link	1	2	1	+	+	+	.	.	+	1	1
Cicendia filiformis Delarbre	+	.	1	1	+	1	.	.	.	1	.
Radiola linoides Roth	.	.	+	2	2	.	.	.	.	+	1
Aira elegans Willd	.	.	+	.	.	.	.	.	.	+	+
Illecebrum verticillatum L.	.	.	.	2	2	2	.	.	.	.	.
Hypericum australe Ten	+	.	.	.	+	.	.	.	.	.	.
Isoetetalia Br.-Bl. 1935											
Lotus angustissimus L.	+	1	+	+	2	1	+	1	+	+	+
Laurentia gasparrini (Tineo) Strobl	.	.	.	.	1	+	1	+	.	+	+
Briza minor L.	.	.	+	.	.	.	.	+	.	+	1
Myosotis sicula Guss	.	.	.	.	1	.	2	.	+	.	.
Lythrum borystenicum (Schrank) Litv	.	.	.	.	2	+	+	.	.	.	.
Centaurium maritimum (L.) Fritsch	.	.	.	.	.	.	.	+	.	2	.
Isoeto-Nanojuncetea Br.-Bl. & R. Tx. ex Westhoff et al. 1946											
Juncus bufonius L.	2	1	1	2	3	1	.	1	+	+	+
Juncus capitatus Weigl	2	1	1	1	.	.	.	+	2	1	.
Mentha pulegium L.	.	.	.	.	.	1	2	2	2	+	2
Juncus pygmeus Richard	.	.	1	2	2	3	2	.	.	.	+
Ranunculus sardous Crantz	.	1	.	.	.	.	.	2	2	+	.
Juncus tenageja Ehrh	.	.	.	2	.	+	1	.	.	.	+
Gaudinia fragilis (L.) Beauv	.	.	.	.	.	.	.	2	.	1	.
Species from Helianthemetea guttatae Br.-Bl. 1952											
Euphorbia exigua L.	.	+	+	.	+	+	.	.	1	2	+
Cynosurus polybracteatus Poiret	2	1	.	.	.	.	.	+	.	.	+
Ornithopus pinnatus (Miller) Druce	.	.	+	.	+	.	.	.	.	.	+
Moenchia mantica (L.) Bartl	.	.	.	.	.	.	.	.	.	+	.
Tuberaria guttata (L.) Fourr	.	.	.	.	.	.	.	.	.	+	.
Galium divaricatum Lam	.	.	.	.	.	.	.	.	.	1	.
Trifolium strictum L.	.	+	.	.	.	.	.	.	.	.	.
Other species											
Linum bienne Miller	1	1	+	.	+	+	+	1	+	.	1
Bellis annua L.	1	1	.	.	.	.	1	2	2	2	2
Plantago lanceolata L.	+	1	1	.	.	.	1	1	1	.	+
Ranunculus ophioglossifolius Vill	.	.	.	.	2	1	1	.	+	.	+
Trifolium micrantum Viv	.	.	.	.	.	.	.	3	1	2	+
Oenanthe pimpinelloides L.	.	1	.	.	.	.	.	1	+	.	.
Carex flacca Schrank	2	2	1	.	.	.	.	.	.	.	.
Ranunculus flabellatus Desf	.	2	2	.	.	.	.	.	.	.	2
Serapias lingua L.	2	+	+	.	.	.	.	.	.	.	.
Romulea columnae Seb et Mauri	1	+	.	.	.	.	.	.	.	.	+
Anagallis minima (L.) Krause	.	.	.	.	.	.	.	+	+	.	.
Vulpia muralis (Kunth) Nees	.	.	.	.	.	.	.	.	.	3	+
Prunella laciniata L.	.	.	.	.	.	.	.	.	.	+	+
Juncus gr. articulatus	.	.	.	.	+	+	.	.	.	.	.
Trifolium resupinatum L.	.	.	.	.	.	.	.	+	+	.	.
Polypogon monspeliensis(L.) Desf	.	.	.	.	.	.	.	.	2	+	.
Lythrum portula (L) D.A. Webb	.	.	.	.	.	+	.	.	.	.	.
Trifolium ligusticum Balbis	.	.	.	.	.	.	.	+	.	.	.
Trifolium subterraneum L.	.	.	.	.	.	.	.	.	.	+	.
Anthoxantum odoratum L.	.	+	.	.	.	.	.	.	.	.	.
Polycarpon tetraphyllum L.	.	.	.	.	.	.	.	1	.	.	.
Agrostis stolonifera L.	.	.	1	.	.	.	.	.	.	.	.
Anthemis cotula L.	.	.	.	.	.	.	.	.	.	+	.
Euphorbia cuneifolia Guss	.	.	.	+	.	.	.	.	.	.	.
Apium crassipes (Koch) Rchb	.	.	.	.	.	.	3	.	.	.	.

Syntaxonomical scheme

QUERCO-FAGETEA Br.-Bl. et Vlieg. 1937
Quercetalia pubescenti-petraeae Klika 1933 corr. Moravec in Béguin et Theurillat 1984
Teucrio siculi-Quercion cerridis (Ubaldi 1988) Scoppola, Filesi 1995
Mespilo germanicae-Quercetum frainetto Biondi, Gigante, Pignattelli et Venanzoni 2001 *arbutetosum unedonis subass. nova*
Mespilo germanicae-Quercetum frainetto Biondi, Gigante, Pignattelli et Venanzoni 2001 *cornetosum sanguineae subass. nova*
Mespilo germanicae-Quercetum frainetto quercetosum roboris Biondi, Gigante, Pignattelli et Venanzoni 2001
Quercetum frainetto-suberis Blasi, Filesi, Fratini et Stanisci 1997

Populetalia albae Br.-Bl. 1931
Populion albae Br.-Bl. 1931
Veronico scutellatae-Quercetum roboris Stanisci, Presti et Blasi 1998

RHAMNO-PRUNETEA SPINOSAE Riv.-God. et Borja 1961
Prunetalia spinosae Tx. 1952
Pruno-Rubion ulmifolii O. de Bolos 1954
Pruno-Rubenion ulmifolii Arnaiz et Loidi 1983
Daphno gnidii-Cytisetum scopariae ass. nova

QUERCETEA ILICIS Br.-Bl. 1947
Pistacio-Rhamnetalia alaterni Rivas-Martinez 1975
Ericion arborae Rivas-Martinez (1975) 1987
Phillyreo latifoliae-Ericetum scopariae ass. nova

HELIANTEMETEA GUTTATI Br.-Bl. 1952
Heliantemetalia guttati Br.-Bl. 1940
Heliantemion guttati Br.-Bl. 1931
Moenchio-Tuberarietum guttati Lucchese et Pignatti 1987

ISOETO-NANOJUNCETEA Br.-Bl. & R. Tx. in Br.-Bl.1949
Isoetetalia Br.-Bl. 1935
Cicendio-Solenopsion laurentiae Brullo et Minissale 1998
Sileno laetae-Isolepetum cernuae ass. nova

Syntaxa quoted in the text

*Agropyro-Rumicion (*Nordh. 40) Tüxen 1950
Carpino orientalis-Quercetum cerridis Blasi 1984
Echinopo siculi-Quercetum frainetto Blasi et Paura 1993
Erico-Quercetum cerridis Arrigoni Mazzanti et Ricceri 1990
Malo florentinae-Quercetum frainetto Biondi, Gigante, Pignattelli et Venanzoni 2001
Melico uniflorae-Quercetum cerridis Arrigoni Mazzanti et Ricceri1990
Melittio-Quercion frainetto Barbero, Bonin, Gamisans et Quezel 1977
Quercetum frainetto-cerridis Blasi 1984
Quercion frainetto-cerridis Horvat 1959

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APPENDIX

Site descriptions of original phytosociological relevés

Tab. 2 - *Mespilo germanicae-Quercetum frainetto arbutetosum unedonis* subass. nova, *cornetosum sanguineae* subass.nova, subass. *quercetosum roboris*

Relévé N°	Place	Cover of high tree layer (%)	Cover of low tree layer (%)	Cover of shrub layer (%)	Cover of herb layer (%)	Relévé area (mq)	Total species
1	Piscina delle Bagnature (Stanisci et al. 1996: Tab.1, rel. 9) (Circeo N.P.)	60	-	40	80	80	20
2	Piscina delle Bagnature (Stanisci et al. 1996: Tab.1, rel. 15) (Circeo N.P.)	50	-	5	30	40	17
3	Piscina della calce (Circeo N.P.)	60	80	50	20	120	17
4	Cocuzza (Circeo N.P.)	100	50	10	20	200	26
5	Cocuzza (Circeo N.P.)	90	60	40	30	150	30
6	Dispensa vecchia (Circeo N.P.)	90	50	10	50	100	26
7	Piscina Murata (Circeo N.P.)	95	40	5	80	150	29
8	Dispensa vecchia (Circeo N.P.)	70	60	10	50	100	24
9	Alla Torre (Circeo N.P.)	90	60	5	30	100	20
10	Piscina delle Bagnature	40	70	20	20	60	28
11	Dispensa vecchia (Circeo N.P.)	80	70	30	50	150	31
12	Dispensa vecchia (Circeo N.P.)	80	60	10	50	120	28
13	Piscinozzi verdesca (Circeo N.P.)	80	60	5	40	80	24
14	Piscina delle Bagnature (Stanisci et al. 1996: Tab.1, rel. 12) (Circeo N.P.)	90	-	80	60	150	27
15	Piscinozzi verdesca (Circeo N.P.)	90	60	5	40	80	30
16	Piscina della Gattuccia (Circeo N.P.)	90	60	60	80	250	26
17	Piscina della Gattuccia (Circeo N.P.)	80	70	50	50	100	27
18	Dispensa vecchia (Circeo N.P.)	70	60	30	80	200	31
19	Piscina della Gattuccia (Circeo N.P.)	100	60	40	50	300	23
20	Cerasella (Circeo N.P.)	70	60	30	20	80	23
21	Piscina della Gattuccia (Padula, 1985, rel. 15) (Circeo N.P.)						29
22	Cerasella (Circeo N.P.)	80	70	50	50	100	26
23	Piscina delle Bagnature (Circeo N.P.)	70	40	5	80	80	25
24	Cerasella (Circeo N.P.)	80	60	15	70	80	35
25	Madonnella (Circeo N.P.)	90	40	70	50	100	30
26	Piscina della Verdesca (Circeo N.P.)	80	70	60	30	100	20
27	Dispensa vecchia (Circeo N.P.)	90	60	30	70	200	30
28	Piscinozzi tranquillo (Circeo N.P.)	60	70	5	60	100	30
29	Cerasella (Circeo N.P.)	80	70	20	60	150	26
30	Piscina delle Bagnature (Stanisci et al. 1996: Tab.1, rel. 11) (Circeo N.P.)	95	-	50	70	100	33

31	Piscina della calce (Circeo N.P.)	90	50	10	80	100	31
32	Rio Nocchia (Circeo N.P.)	50	85	30	20	250	20
33	Piscina delle Bagnature (Stanisci et al. 1996: Tab.1, rel. 10)	90	-	40	60	150	33
34	Rio Nocchia (Circeo N.P.)	95	60	50	70	100	32
35	Piscina del Carpino (Circeo N.P.)	60	80	40	70	80	31
36	Cerasella (Circeo N.P.)	80	60	70	80	100	22
37	Madonnella (Circeo N.P.)	90	30	80	60	150	28
38	Piscina della Verdesca (Circeo N.P.)	85	55	40	30	110	19
39	Lestra Sarachetta (Circeo N.P.)	85	60	60	40	100	33
40	Piscina delle Bagnature (Stanisci et al. 1996: Tab.1, rel. 14) (Circeo N.P.)	90	-	5	40	80	26
41	Rio Nocchia (Circeo N.P.)	90	60	40	60	150	34
42	Piscina delle Bagnature (Circeo N.P.)	70	80	5	90	100	21
43	Fosso dello Zepparo (Circeo N.P.)	85	30	15	95	75	15
44	Fosso dello Zepparo (Circeo N.P.)	90	70	30	85	120	22
45	Fosso dello Zepparo (Circeo N.P.)	95	40	30	20	90	14
46	Rio Nocchia (Circeo N.P.)	95	30	50	40	90	17
47	Rio Nocchia (Circeo N.P.)	90	35	20	70	100	20
48	Rio Nocchia (Circeo N.P.)	80	40	60	25	120	21
49	Rio Nocchia (Circeo N.P.)	85	70	65	40	120	19
50	Bosco di Foglino	90	-	10	60	150	32
51	Bosco di Foglino	80	40	70	50	150	32
52	Bosco di Foglino	85	60	80	30	200	32
53	Bosco di Foglino	80	10	95	20	150	23
54	Bosco di Nettuno	85	-	30	90	150	20
55	Bosco di Nettuno	90	-	90	50	200	30
56	Bosco di S. Anastasio	90	50	90	30	150	19
57	Bosco di Nettuno	95	-	50	40	150	23
58	Bosco di Nettuno	90	60	50	90	150	25
59	Bosco di Nettuno	90	-	60	90	150	25
60	Bosco del Padiglione	70	90	50	80	100	33
61	Bosco del Padiglione	80	50	70	50	100	37
62	Bosco del Padiglione	60	80	80	40	150	38
63	Bosco del Padiglione	85	-	70	30	200	31
64	Bosco del Padiglione	85	50	40	40	100	33
65	Bosco del Padiglione	75	-	25	20	100	30
66	Bosco di Foglino	50	-	70	30	200	43
67	Bosco di Foglino	80	40	90	20	200	39
68	Bosco di Foglino	75	40	60	60	150	36
69	Bosco di Foglino	80	-	70	40	100	34
70	Bosco di Foglino	90	-	90	20	200	36
71	Bosco di Foglino	95	-	60	75	150	31

Tab. 3 - *Daphno gnidii-Cytisetum scopariae* ass. nova

1	Bosco del Padiglione			100		20	9
2	Bosco di Nettuno			100		6	8
3	Bosco di Nettuno			100		10	17
4	Piscinozzi tranquillo (Circeo N.P.)			90	15	17	17
5	Piscina del carpino (Circeo N.P.)			90	60	20	20
6	Cerasella (Circeo N.P.)			90	70	20	15
7	Cerasella (Circeo N.P.)			80	75	9	15
8	Piscina del carpino (Circeo N.P.)			90	80	12	12
9	Bosco di Nettuno			100		10	13
10	Bosco di S. Anastasio			100		10	13
11	Bosco di Foglino			95		8	10
12	Bosco di Foglino			100		18	9
13	Bosco di S. Anastasio			100		10	8

Tab. 4 - *Phillyreo latifoliae-Ericetum scopariae* ass. nova

1	Bosco di Foglino	-	-	100	20	8	7
2	Lestra Cerasella (Circeo N.P.)	15	-	100	5	40	14
3	Piscina dei Porcelli (Circeo N.P.)	15	-	90	5	10	12
4	Bosco di Foglino	-	-	100	-	8	7
5	Lestra Cerasella (Circeo N.P.)	15	-	100	10	80	9
6	Piscina dei Porcelli (Circeo N.P.)	15	-	95	5	90	14
7	Piscina dei Porcelli (Circeo N.P.)	15	-	100	5	50	16
8	Lestra Cerasella (Circeo N.P.)	15	-	95	5	30	15
9	Lestra Cerasella (Circeo N.P.)	30	-	100	5	40	19
10	Piscina dei Porcelli (Circeo N.P.)	40	-	100	5	30	11
11	Piscina dei Porcelli (Circeo N.P.)	20	-	100	5	40	15
12	Bosco di Foglino	-	-	100	-	100	11
13	Bosco di Foglino	-	-	50	-	50	12
14	Bosco di Foglino	60	-	70	15	80	16
15	Bosco di Foglino	80	30	90	5	150	15
16	Bosco di Foglino	75	-	80	10	100	12
17	Bosco di Foglino	50	-	90	10	100	9

Tab. 5 - *Moenchio-Tuberarietum guttatae*

1	Giro della madonnella (Circeo N.P.)				70	25	35
2	Giro della madonnella (Circeo N.P.)				80	7	31
3	Giro della madonnella (Circeo N.P.)				70	12	30
4	Bosco di Nettuno				70	10	27
5	Bosco di Nettuno				70	10	30
6	Bosco di Nettuno				80	15	15
7	Bosco di Nettuno				90	15	28
8	Giro della madonnella (Circeo N.P.)				70	6	16

Tab. 6 - *Sileno laetae-Isolepetum cernuae* ass.nova

1	Bosco di Foglino				70	5	14
2	Bosco di Foglino				60	2	20
3	Bosco di Foglino				50	3	19
4	Selva Demaniale (Circeo N.P.)				50	1	13
5	Selva Demaniale (Circeo N.P.)				70	3	19
6	Selva Demaniale (Circeo N.P.)				60	1	18
7	Bosco di Foglino				50	2	12
8	Bosco di Foglino				70	15	22
9	Bosco di Foglino				50	25	20
10	Bosco di Foglino				70	2	25
11	Bosco di Foglino				80	2	24