

## *Juniperus oxycedrus* L. subsp. *oxycedrus* and *Paliurus spina-christi* Miller scrubs in the intermontane areas of the Abruzzo region (Central Apennine, Central Italy)\*

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### Abstract

*Juniperus oxycedrus* L. subsp. *oxycedrus* and *Paliurus spina-christi* Miller scrubs in the intermontane areas of the Abruzzo region (Central Apennine, Central Italy). The present paper focuses on a phytosociological, chorological and syndynamical analysis of the *Juniperus oxycedrus* subsp. *oxycedrus* communities, widespread in the mountain basin of the calcareous central Apennine. Various other species are physiognomically relevant in those coenoses like *Rhamnus saxatilis* subsp. *infectoria*, *Chamaecytisus spinescens*, *Osyris alba*, *Buxus sempervirens*, *Daphne sericea*, and *Paliurus spina-christi*. These communities are included in a vegetation mosaic with grazed areas and garrigues (*Cisto-Micromerietea* Oberd. 1954), showing dynamical connections with forest coenoses dominated by *Quercus pubescens* (*Ostryo-Carpinion orientalis* Horvat (1958 n.n.) 1959 and *Quercion pubescenti-petraeae* Br.Bl.1932 em. Riv.Mart.1972).

Within the *Cytision sessilifolii* Biondi in Biondi, Allegrezza, Guitian 1988, an endemic syntaxon who defined an apenninic scrub communities, two coenoses are found: the new association *Chamaecytiso spinescentis-Juniperetum oxycedri* with two subassociations, and *Rhamno saxatilis-Paliuretum spinae-christi* Biondi 1999.

The coenological and chorological features (high percentage of Mediterranean (Steno- and Euri-) and Eastern species) of the red juniper scrub in the apenninic area, need a new synsystematic assessment, as they suggest strong similarities with analogues described in Eastern Europe.

Key words: Central Apennine, scrub communities, phytosociology, *Juniperus oxycedrus* subsp. *oxycedrus*, *Paliurus spina-christi*, syntaxonomy.

### Riassunto

Vengono presentati i risultati di uno studio fitosociologico sulle comunità arbustive a dominanza di *Juniperus oxycedrus* subsp. *oxycedrus*, presenti nelle principali conche intermontane dell'Appennino calcareo abruzzese. Gli arbusteti risultano caratterizzati oltre che da ginepro, da *Rhamnus saxatilis* subsp. *infectoria*, *Chamaecytisus spinescens*, *Osyris alba*, *Buxus sempervirens*, *Daphne sericea*, e *Paliurus spina-christi*, ed inseriti in un mosaico con pascoli secondari e garighe (*Cisto-Micromerietea* Oberd. 1954), risultando dinamicamente legati a cenosi forestali dominate da *Quercus pubescens* (*Ostryo-Carpinion orientalis* Horvat (1958 n.n.) 1959 e *Quercion pubescenti-petraeae* Br.Bl.1932 em. Riv.Mart.1972).

Sono state individuate due associazioni, il *Chamaecytiso spinescentis-Juniperetum oxycedri* ass.nova, con due subassociazioni, e il *Rhamno saxatilis-Paliuretum spinae-christi* Biondi 1999, che mettono in evidenza l'autonomia cenologica e corologica (alta percentuale delle specie Mediterranee (Steno- ed Euri-) ed Orientali) dei ginepretti appenninici rispetto al resto delle comunità che afferiscono all'alleanza *Cytision sessilifolii* Biondi in Biondi, Allegrezza, Guitian 1988, riproponendo l'esigenza di un collegamento sinsistemico con le comunità arbustive descritte nell'Europa orientale.

Parole chiave: Appennino centrale, cespuglieti, fitosociologia, *Juniperus oxycedrus* subsp. *oxycedrus*, *Paliurus spina-christi*, sintassonomia.

### Introduction

*Juniperus oxycedrus* subsp. *oxycedrus*-dominated scrubs are very much present in the central Apennine and are widespread throughout the major calcareous massifs in the Abruzzo region. The vegetation landscape here, is characterized by a pattern of scattered shrub populations where the red juniper is dominant, within garrigues at different successional stages, in areas which have previously been largely affected by grazing and are now abandoned.

These aggregations are belonging to the series of the thermophylous continental oak-woods, dominated by *Quercus pubescens*. They could also represent early successional stages of mixed evergreen-deciduous communities as it is found on drier sites, or in *Ostrya*

*carpinifolia* stands and in other semimesophylous mixed forest on cooler sites.

The aim of this paper is to contribute to the interpretation of the Apennine shrub communities, through a structural, chorological and syndynamical analysis. The main purpose is the setting up of an appropriate syntaxonomical scheme to promote the correct interpretation of the scrub communities in peninsular Italy.

### Generalities

The sampling of the data has been carried out in the intermontane areas of the Abruzzo (in the district of Capestrano, Peligna, Fucino and Navelli basins, and some edging areas) located in the inner central

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Apennine, within the main limestone massifs of this region (Fig.1).

The analyzed territory, is characterized by sequences of shelves (Jurassic-Cretaceous inf.) built up by granular limestones, alternated with flint-layer, organogenic limestone, marly and clayey limestones. On the other side, the pediment of the mountain slopes and the bottom of the intermontane basins, are characterized by Holocene clayey lacustrine sediments alternated with sandy and conglomerated ones (AA.VV., 1988). The stands under study are located in different morphological conditions, from steep slopes, on fans at the pediment and the edges of the basin, on almost nearly-flat sites. The slope sites all are characterized by high percentages of clastic rocks and rocky outcrops, who represented a distinctive element of the hilly and mountain belts of the Apennine laid on calcareous lithologies.

From the climatic point of view, the preliminary surveys on the bioclimatology of Abruzzo (Tartaglino & Tammaro, 1995), indicate that the sites under study belong to the Temperate Region, as evidenced by the characteristics of the thermopluviometrical station at Avezzano and, partially, to the Mediterranean Region (Sulmona: Fig.2). The ombrothermic diagrams, show a concentration of rainfall during winter. It is, however, worth pointing out a significant amount of summer drought, which is characteristic of all the Apennine intermontane areas, and particularly intense in the

Capestrano district, the latter displaying the lowest values of yearly P in Abruzzo. According to the bioclimatic classification by Rivas-Martinez, the stands can be ranked into the uppermontane thermotype and into a higher subhumid ombrotype in the inner and more elevated stands (Avezzano) (Tartaglino, unpublished data), and an upper mesomediterranean thermotype and a lower subhumid ombrotype in the geographical zones which are closer to the edge of the basins, at a lower altitude, partially affected by the Mediterranean climate (Sulmona) (Biondi & Baldoni, 1994).

### Data, methods and results

During the survey season 1995-1996, 49 releves were sampled on scrubs of *Juniperus oxycedrus* subsp. *oxycedrus*, using the current phytosociological approach, at altitudes ranging from 370 m to approx. 1080 m above sea level. A statistical multivariate analysis was performed on the resulting table, according to the classification and ordination procedures of the Syn-Tax program (Podani, 1995). The abundance data was chosen, in order to discriminate more properly the communities with few species, where the cover values are significant as shown in other studies (Cutini, 1996; Cutini & Blasi, 2002). Life-forms and chorological spectra of the resulting groups were performed, to bet-

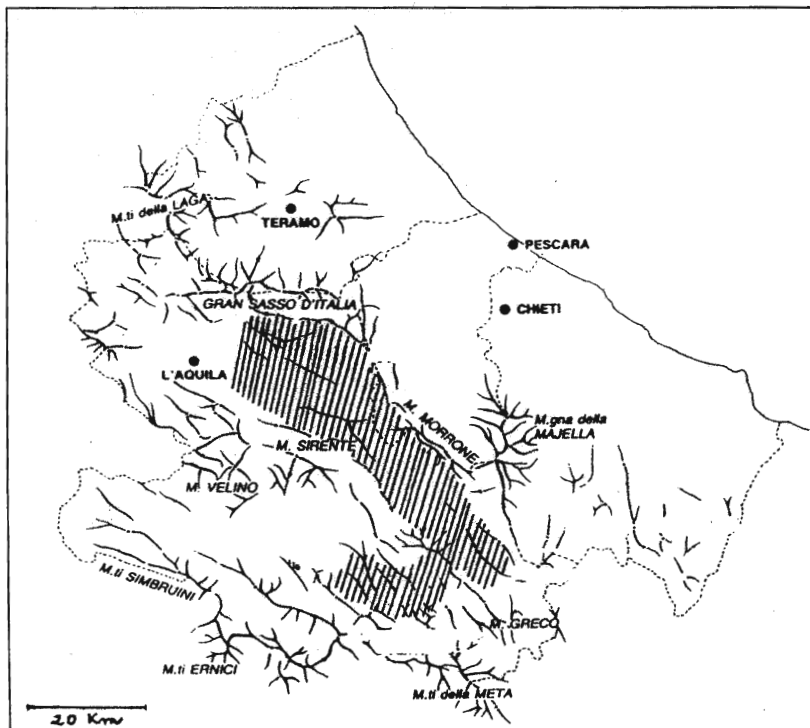


Fig. 1 - Study area

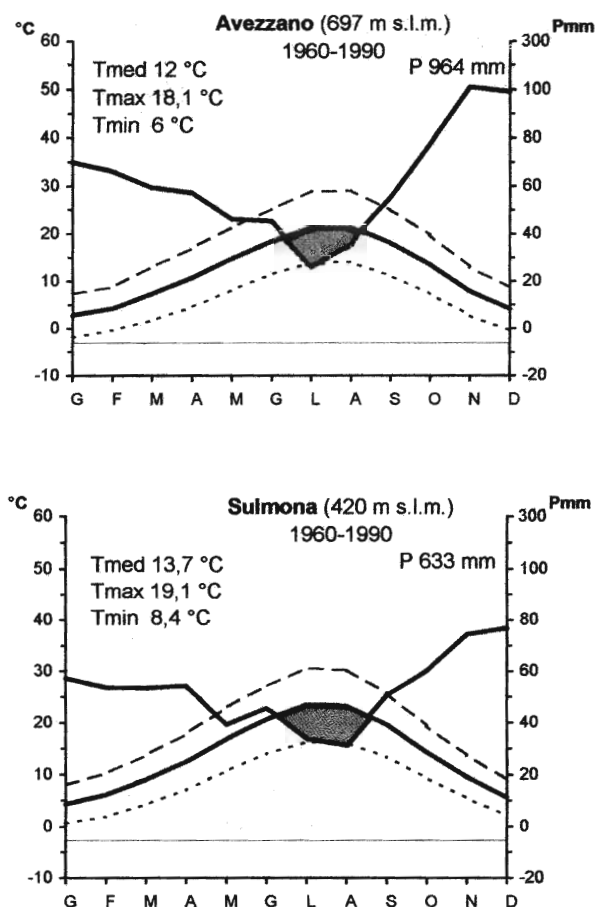


Fig. 2 - Ombrothermic diagrams relative to Avezzano and Sulmona stations

ter point out the real biogeographical value of the units concerned.

As a result, this classification shows two major distinct groups (Fig. 3): group A, which is represented by communities on slope reaching the highest altitudes, this group being characterized by *Juniperus oxycedrus* subsp. *oxycedrus*, *Chamaecytisus spinescens* and *Lonicera etrusca*; group C, which relates to thermophilous scrubs, found at lower altitudes and prevalently formed by *Paliurus spina-christi* and *Spartium junceum*. The two groups are separated by a single releve ("group" B), which is clearly distinct from all the other ones, being the only one with *Cotinus coggygia* (this releve is clearly belonging to *Junipero-Cotinetum* by Biondi *et al.* (1988).

Going into more details, six physiologically well-characterized groups can be distinguished: a first group (A1), with *Juniperus oxycedrus* and *Lonicera etrusca*, barely diversified from the floristic point of view: con-

nected to A1 is the second group (A2) which is distinguished by *Buxus sempervirens*: the next group (A3) is floristically well distinguished by the presence of *Daphne sericea*, *Cistus creticus* subsp. *creticus* and *Dorycnium hirsutum*, with red juniper as constant component. More thermophilous units at lower altitudes, dominate the remnant group (C), clearly separated from the other ones: in the group C1, *Paliurus spina-christi* and *Pistacia terebinthus* are found, while in the last group (C2), *Spartium junceum* and *Clematis flammula* are present with high cover values.

The result obtained from the classification is confirmed by their ordination (Fig. 4). The two axes as a whole account for some 40% of the total variance, and show along ax I the distribution of the releve groups according to an edaphic (and lithologic) factor. Actually, the communities with *Juniperus oxycedrus* and *Lonicera etrusca* and those with *Daphne sericea* are located on stony limestone slopes, under conditions of scarcely developed soils (the types apparently overlapping, are well split along ax III). On the other side, the communities of *Paliurus spina-christi* and *Spartium junceum* seem to prefer more evolved edaphic conditions. Along axis II, the distribution of the communities appears to be controlled by the temperature, being the mesophilous aggregations with *Buxus sempervirens* growing on the northward slopes at one side of the gradient, opposite to the thermophilous communities with *Paliurus spina-christi*, of the lower altitudes, at the other.

These ecological factors seem to be crucial for the development of the scrub at this geographical scale.

### Syntaxonomy and conclusions

From the syntaxonomical point of view, the scrub are included in the *Prunetalia spinosae* order, on the class *Rhamno cathartici-Prunetea spinosae*, notwithstanding the scarcity of characteristic elements present there. Those syntaxa characterize the Euro-Asiatic and Mediterranean communities, dynamically connected to the mixed deciduous forest of the class *Quercio-Fagetea*. At a lower hierarchical level, the scrubs dominated by red juniper, are to be referred to the alliance *Cytision sessilifolii*, characteristic of the hilly and submontane belt of the central Apennine, on calcareous and marly-calcareous lithotypes (Biondi *et al.*, 1988; Cutini & Blasi, 1995; Cutini & Blasi, 2002). Those habitats, and consequently the coenoses, appear to be well differentiated from the typical mantles of the forest

edges. In this case, these stands of scrub are scattered into a meadows-dominated landscape, as emphasized by the large amount of camephytic and nanophanerophytic species (Fig. 5), belonging to *Cisto-Micromerietea* heaths, a syntaxon encompassing heaths and garrigues of the Central and Eastern Mediterranean areas (Brullo *et al.*, 1997; Pirone & Tamaro, 1997; Biondi, 2000).

**CHAMAECYTISO SPINESCENTIS-JUNIPERETUM OXYCEDRI** ass. nova (Tab. 1)

This is the most common and characteristic community of the intermontane basins, growing on limestones with huge rocky outcrops. In the Abruzzo, this community can be found at altitudes ranging from 600 to 1100 m above sea level, prevalently on South facing slopes, and on slightly steep stony slopes and rocky outcrops.

The scrub communities are prevalently dominated by *Juniperus oxycedrus* subsp. *oxycedrus* sometimes very dense. Secundarily *Lonicera etrusca* may occur. Beside these two species, *Chamaecytisus spinescens* and *Rhamnus saxatilis* subsp. *infectoria* are present, as characteristic elements of the community type of xeric and

stony habitats (releve type n. 4). In this stands, relevés 7, 8, and 9 describe a *Spartium junceum* variant, developed on mature soil conditions, whereas another *Cytisus sessilifolius* (and *Brachypodium rupestre*) represent merely successional stages.

Chorologically, a higher percentage of the Euroasiatic taxa are observed, followed by high percentages of Eurimediterranean and Eastern species, observed in other communities of the submontane belt in the Central Apennine (Fig. 5). This association is dynamically related to garrigues of *Cytisus spinescens*-*Saturejion montanae* (*Cisto-Ericetalia*, *Cisto-Micromerietea*) (Pirone & Tamaro, 1997), syntaxon more recently included into *Cisto cretici-Ericion manipuliflorae* alliance (Biondi, 2000). As a matter of facts, these scrub are entered by a large number of species of the mentioned garigues, such as *Satureja montana* subsp. *montana*, *Globularia meridionalis*, *Aethionema saxatilis*, *Helianthemum canum*, *Ononis pusilla*, *Cephalaria leucantha*, *Fumana procumbens*. Dynamically, the fully developed communities are represented by a *Quercus pubescens* or *Ostrya carpinifolia* dominated forest (belonging to *Ostryo-Carpinion orientalis* alliance), while the more continental types, occurring at the highest al-

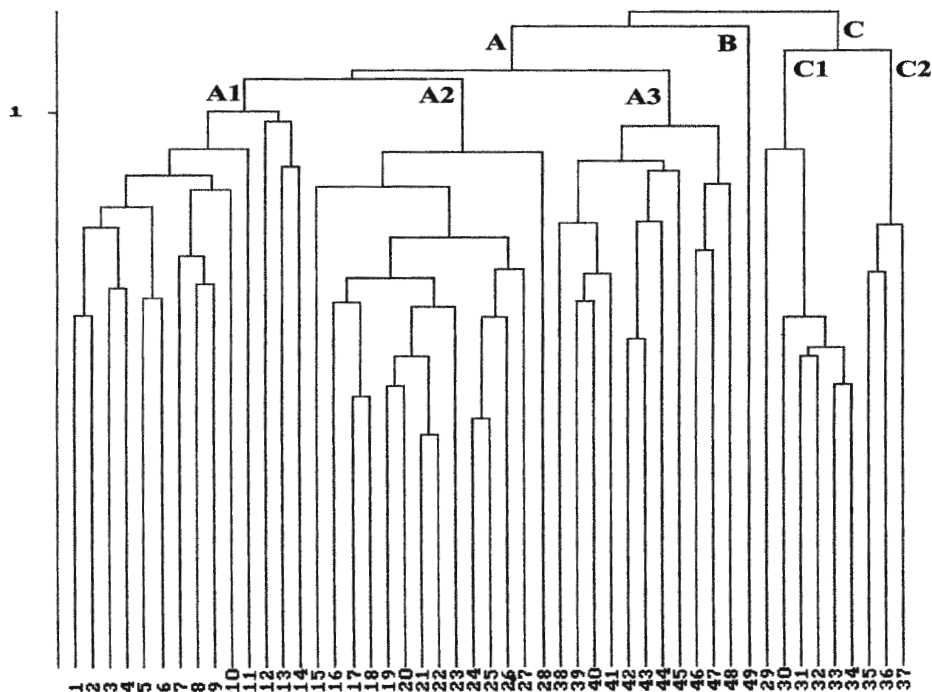


Fig. 3 - The result of relevés classification obtained through quantitative data (Chord distance, Average link). The groups are physiologically characterized by:

A1 *Juniperus oxycedrus*, *Lonicera etrusca*; A2 *Juniperus oxycedrus*, *Buxus sempervirens*, *Chamaecytisus spinescens*; A3 *Juniperus oxycedrus*, *Daphne sericea*; B *Cotinus coggygia*; C1 *Paliurus spina-christi*, *Rhamnus saxatilis*; C2 *Spartium junceum*, *Paliurus spina-christi*

titudes, are to be related to forest formations dominated by *Quercus pubescens* (*Quercion pubescenti-petraeae*).

Within the typical association, it is possible to distinguish two subtypes, in which *Buxus sempervirens* and *Daphne sericea* are physiologically dominant. In those communities, these two biogeographically interesting species stand out over the other ones, thereby being ranked at the hierarchical level of subassociation.

*CHAMAECYTISO SPINESCENTIS-JUNIPERETUM*  
*OXYCEDRI BUXETOSUM SEMPERVIRENTIS* subass.  
nova

*Buxus sempervirens* is a relict of the Tertiary, at present scattered over distinct refuge-areas, from the Iberian Peninsula in the Atlantic Ocean to the Caspian Sea, through France, Italy, the Balkan peninsula, and the Black Sea (Hegi, 1925; Chiarugi, 1950; Scharfetter,

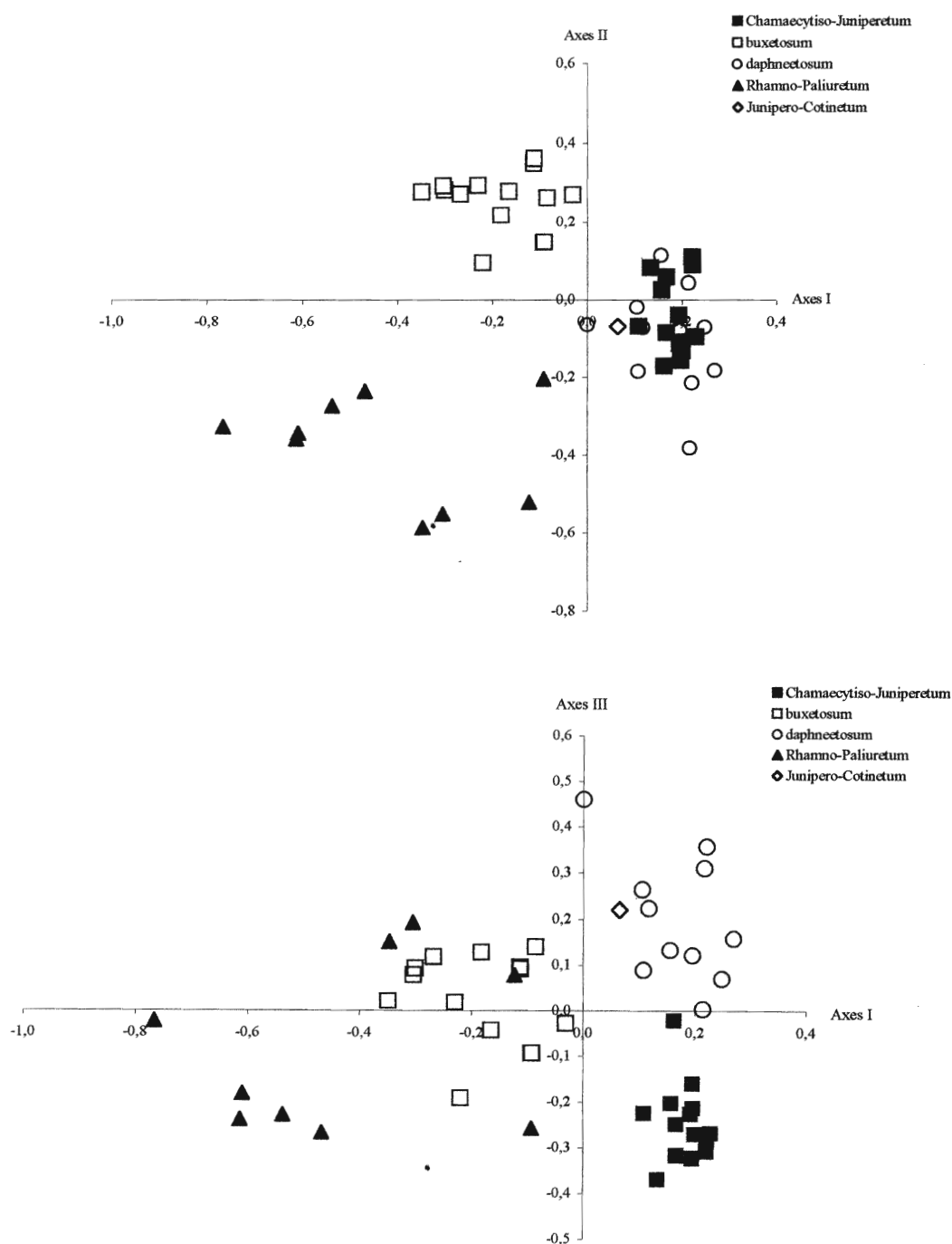


Fig. 4 - Ordination of releves (Principal Component Analysis)





1953; Fenaroli & Gambi, 1976). In Italy, it scattered from the western Alps to the southern Apennine (Lucania) (Banti, 1954; Agostini, 1955; Montelucci, 1960; Mondino, 1989; Orsomando *et al.*, 1992), in *Quercus pubescens*

woods, *Ostrya carpinifolia* woods, and in thermophilous beech forest, although often abundant in shrubland and garrigues, throughout Italy (Mondino, 1989; Orsomando *et al.*, 1992) as well as in the Abruzzo.

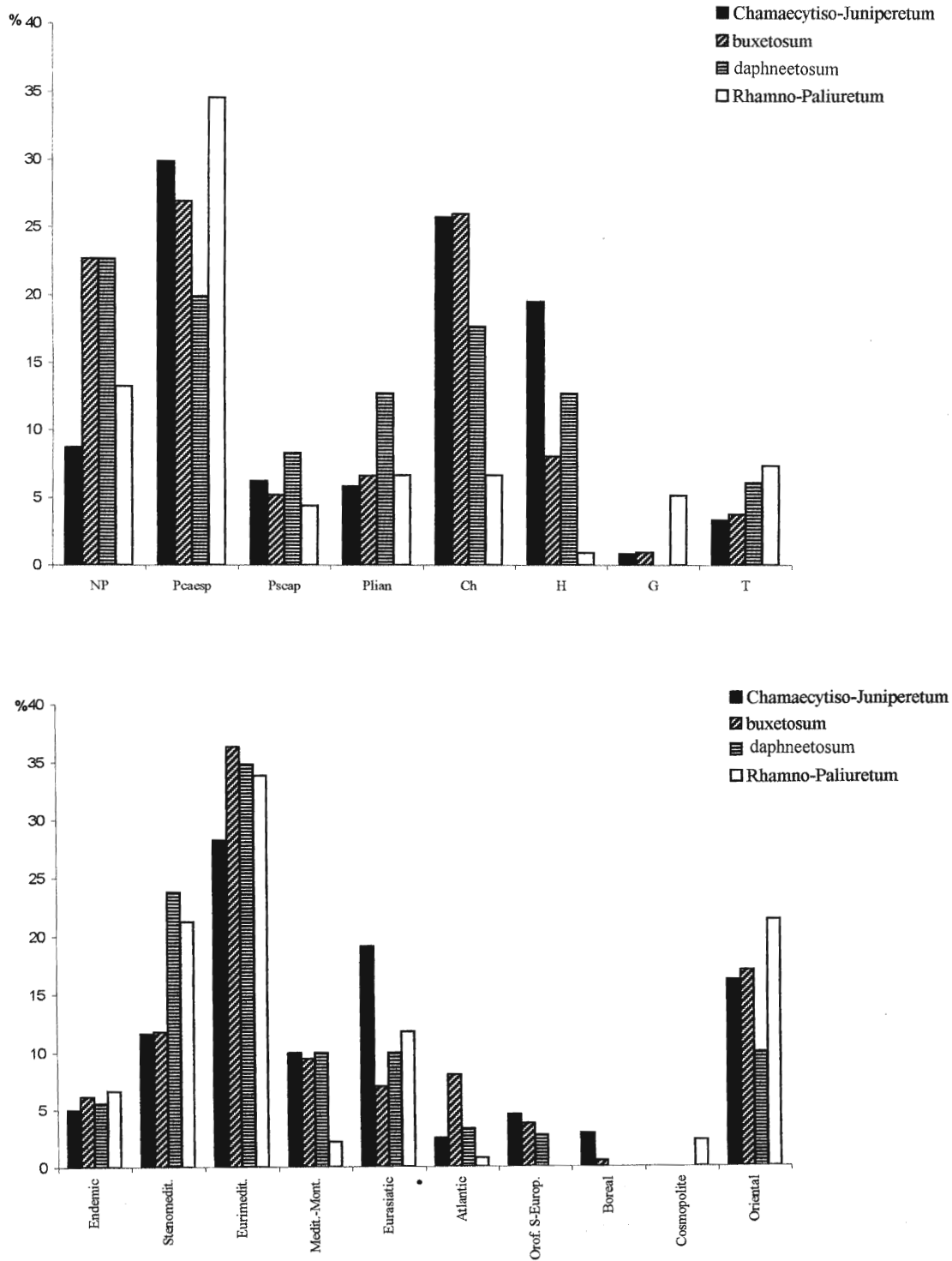


Fig. 5 - Biological and chorological spectra of the studied populations, obtained by using the species percent frequency in the different groups



In the study area, the scrub dominated by *Buxus sempervirens* is usually found along the North facing slopes at lower altitudes than the typical *Chamaecytiso-Juniperetum* ones. Some comparable stands have been found in the French Alp (Delphinat district) and assigned to *Rhamno saxatili-Buxetum* (Bannes-Puygiron, 1933; Tüxen, 1952). In these communities, however, the presence of *Amelanchier ovalis* and *Viburnum lantana* suggest a more continental character than in the standy areas, which justifies their inclusion within the alliance *Berberidion vulgaris*, as pointed out by Tüxen (1952). The same association was later found in the Catalan pre-Pyrenean districts (Perdigò & Ariso, 1979) at elevation around 1000m above sea level, corresponding to the *Fagus* forest belt, or as thicket widespread over large areas (Soriano & Sebastià, 1990). These support the proposed classification as *Amelanchiero-Buxion*, a unit representing the scrub of the mountain belt.

In our case, we have ranked this unit at a subassociation level (relevé type n. 19) because of the poor floristic differentiation from the association itself, the climatic and morphological homogeneity of the investigated stands and, most of all, because of the contiguity with analogues communities of the *Cisto-Micromerietea* garrigue. Differential species are *Buxus sempervirens*, *Paliurus spina-christi* (and *Osyris alba*). The latter, in particular, is very active in the dynamical recovery processes of Mediterranean maquis (as well as of mixed deciduous forest) (Biondi, 1985; 1999), being often connected to scrub communities displaying the

same mesophyllous features, as the *Buxus* communities.

Chorologically, the differences from the typical association can be summarized in a lower percentage of Euroasiatic taxa and in the remarkable increase of the Atlantic ones, which are linked to the presence of *Buxus sempervirens*.

This community grows along the northern slopes of the colline-submontane belt of the intermontane basins, and is dynamically related to the garrigue of *Osyris albae-Cistetum cretici buxetosum sempervirentis* (Pirone & Tammaro, 1997; Biondi, 2000), while the more developed vegetation types are represented by *Quercus pubescens* woodlands, which syntaxonomically are a form of transition between *Ostryo-Carpinion orientalis* and *Quercion pubescenti-petraeae*.

Similar shrub-communities have been found in the Central Apennine (Umbria and Marche) and interpreted as two subtypes of the *Junipero oxycedri-Cotinetum coggygiae* association, subass. *buxetosum* and subass. *osyridetosum* (Biondi *et al.*, 1988).

*CHAMAECYTISO SPINESCENTIS-JUNIPERETUM OXYCEDRI DAPHNEETOSUM SERICEAE* subass. nova

This subassociation is found at lower altitudes as the former one (approx. 300-700 m above sea level) and South and West facing slopes. Differential species are *Daphne sericea*, *Cistus creticus* subsp. *creticus* and *Dorycnium hirsutum*. *Daphne*, in particular, has an Eastern Mediterranean-mountain distribution (Fig. 6) and in the Italian peninsula it is present from Tuscany to

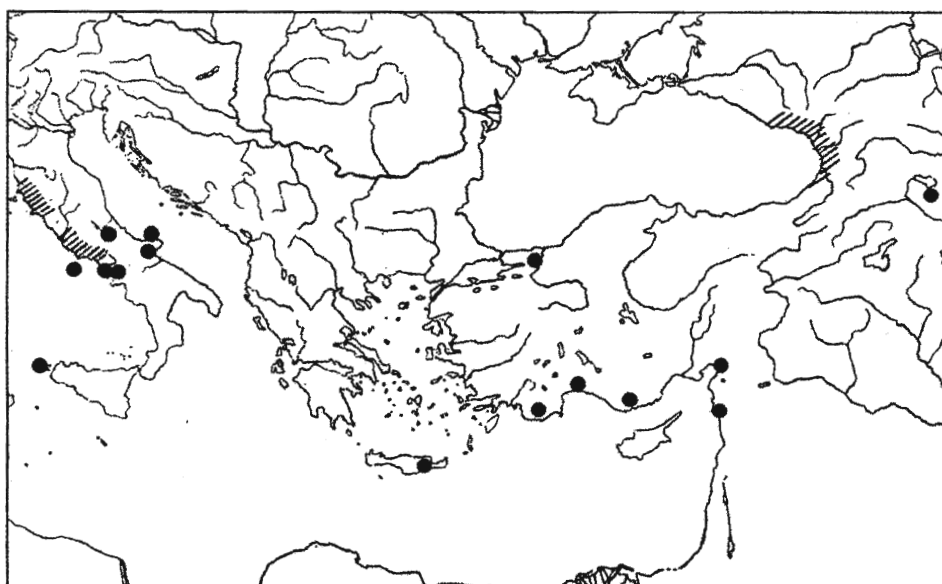
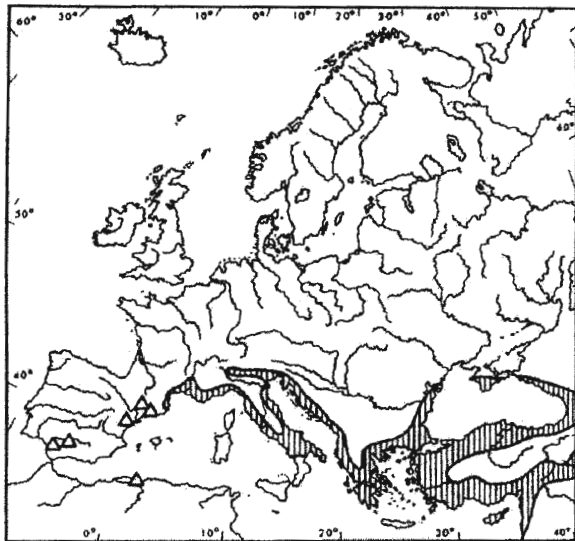
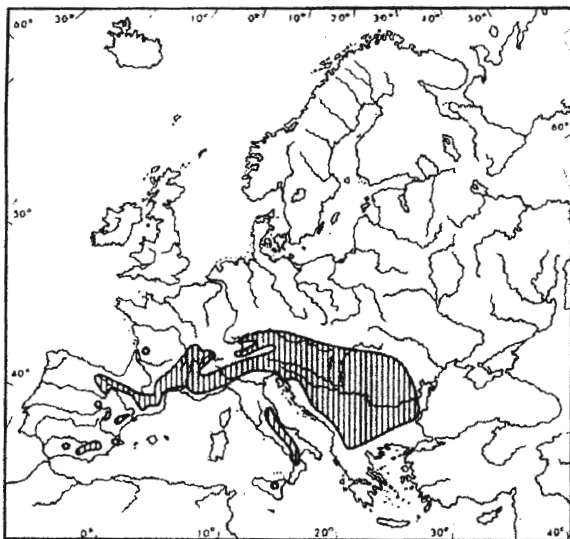


Fig. 6 - Distribution of *Daphne sericea* (according to Francini E. & Messeri A., 1955)



A



B

Fig. 7 - Distribution of *Paliurus spina-christi* (a) and *Rhamnus saxatilis* subsp. *infectoria* (b) (according to De Bolòs & Vigo, 1990)

Campania, while it is not so common in zones of the Adriatic Sea at same latitude. In this community, many taxa are characteristic of the alliance *Quercion ilicis* (*Clematis flammula*, *Quercus ilex*, *Phyllirea latifolia* and *Rubia peregrina*), all emphasizing the thermophilous character of this syntaxon. Nevertheless, if we consider the floral assembly, we can hardly ascribe this community into *Quercetum ilicis* class.

This subassociation (releve type n. 36) indeed, represent the transitional shrub communities of the colline belt of the Abruzzo Apennine, on calcareous bedrocks on South facing slopes, in contact with sclerophyllous-deciduous mixed formations. Chorologically, besides

the Eurimediterranean dominants, a high percentage of Stenomediterranean species is observed: the latter represents within *Cytisium sessilifolii* alliance, the most thermo-xerophilous type, very close to the range limits of *Prunetalia spinosae*. This accounts for the impoverishment of the floristic richness at the highest hierarchical levels. In this respect, some kind of similarity with *Asparago acutifolii-Osyridetum albae* becomes evident (Allegranza *et al.*, 1997). It has been described for the calcareous rocky habitats in the gorges of the Apennines in the region of Marche, and is dynamically related to the thermophilous *Quercus pubescens* woods.

This subassociation represent, within this serie, a transition from the garrigue of *Osyrido albae-Cistetum cretici daphneetosum sericeae* (Pirone & Tamaro, 1997; Biondi, 2000), wich represent one of the most thermophilous aggregation in the Abruzzo colline belt, to the mixed evergreen sclerophyllous and deciduous communities belonging to *Orno-Quercetum ilicis*.

#### *RHAMNO SAXATILIS-PALIURETUM SPINAE-CHRISTI* Biondi 1999 (Tab. II)

*Paliurus spina christi*-dominated scrub, seem to be an pioneer stage, as emphasized by the few rare elements belonging to the *Prunetalia spinosae* order. Their floristic composition shows elements that could be connected to the *Buxus sempervirens* subassociation, in wich *Paliurus* is somewhat present, although it represents a more thermo-xerophilous community.

In these aggregations, *Rhamnus saxatilis* subsp. *infectoria* is an active colonizer in the extreme stony and rocky outcrops in the sites where the association is present (Fig. 7). This type of vegetation is very much similar to *Rhamno intermedii-Paliuretum spinae-christi* of the Eastern Adriatic area, recently included in own syntaxa, as *Rhamno-Paliurion spinae-christi*, *Paliuretalia spinae-christi* and *Paliuretea spinae-christi* (Trinajstic, 1996), as also pointed out by Biondi (1999). In both contexts, the presence of *Juniperus oxycedrus* subsp. *oxycedrus*, *Pistacia terebinthus*, and *Clematis flammula* can be observed. The communities found in the Abruzzo might be considered a Western Adriatic vicariant of the Dalmatian *Paliuretum*.

The very few available data and the poor knowledge of the Illyrian communities, do not allow the use of the synsystematic scheme proposed by Trinajstic (1996). Furthermore, the scarcity of characteristic and differentiating species makes it difficult to assign them correctly to the highest ranks (order and class). From the above considerations, the communities that have been found are to be ascribed to the *Rhamno-Paliuretum* as-

Table II

	Altitude (m a.s.l.)	370	260	265	275	265	280	300	290	520	
	Aspect	-	ESE	SE	SE	E	E	E	E	-	
	Slope (°)	-	10	20	10	10	20	15	10	-	
	Coverture (%)	100	90	85	80	90	95	90	90	90	
	Vegetation height (cm)	200	250	200	200	180	200	160	180	300	
	Stone (%)	-	-	-	-	-	-	-	-	20	
	Rocky outcrops (%)	-	-	-	-	-	-	-	-	-	
	Surface (mq)	60	25	30	20	25	40	20	20	16	
		40	41	42	43	44	45	46	47	48	
<hr/>											
	Rhamno saxatilis-Paliuretum spina-christi Biondi 1999										
SE-EUROP.	Paliurus spina-christi Miller	1	5	5	4	4	4	1	2	1	V
EURIMEDIT.	Pistacia terebinthus L.	2	+	1	+	1	2	1	1	+	V
SE-EUROP.	Rhamnus saxatilis Jacq.subsp.infectoria (L.) P.Fourn.	1	2	2	+	2	2	.	.	.	IV
EURIMEDIT.	Osyris alba L.	.	1	.	.	.	+	1	.	.	II
	variant to Spartium junceum										
EURIMEDIT.	Spartium junceum L.	.	.	.	.	.	.	4	3	4	II
EURIMEDIT.	Clematis flammula L.	+	.	.	.	.	.	2	1	2	II
	Cytisium sessilifolii Biondi in Biondi, Allegrezza, Guitian 1988										
EURIMEDIT.	Juniperus oxycedrus L. subsp. oxycedrus	5	.	1	2	1	2	.	.	+	IV
EURIMEDIT.	Lonicera etrusca Santi	+	.	.	.	.	.	.	+	+	II
CENTRO-EUROP.	Coronilla emerus L. subsp.emeroides (Boiss. Et Spruner) Hayek	.	.	.	.	.	.	.	+	.	I
	Prunetalia spinosae Tuxen 1952										
	Rhamno-Prunetea Rivas Goday, Borija Carbonell 1961 ex Tuxen 1962										
PALEOTEMP.	Rosa canina L.	+	.	1	.	.	.	.	.	+	II
PALEOTEMP.	Crataegus monogyna Jacq.	+	.	.	.	.	+	.	.	.	II
EURIMEDIT.	Rubus ulmifolius Schott	.	.	.	.	.	.	+	.	+	II
N-EURIMEDIT.	Rubus canescens DC.	.	.	.	.	.	.	.	.	2	I
EUROP.-CAUCAS.	Prunus spinosa L.	.	.	.	.	.	.	1	.	.	I
EURASIAT.	Cornus sanguinea L.	.	.	.	.	.	.	.	+	.	I
	Quercetalia pubescenti-petraea Klika 1933 corr. Moravec in Beguin, Theurillat 1984										
	Quercu-Fagetea Br.Bl. et Vlieg 1937 em. Oberdorfer 1992										
SE-EUROP.	Quercus pubescens Willd.	1	.	.	.	+	+	1	1	1	IV
S-EUROP.-SUDSIB.	Fraxinus ornus L.	.	+	+	.	.	+	+	.	+	III
PONTICA	Carpinus orientalis Miller	+	.	.	.	.	.	.	+	.	II
EURIMEDIT.	Acer monspessulanum L.	.	.	.	.	.	.	.	1	.	I
	Festuco-Brometea Br.Bl. et Tuxen 1947										
PALEOTEMP.	Bromus erectus Hudson	.	.	+	+	+	.	1	2	+	IV
ENDEM.	Phleum ambiguum Ten.	.	.	+	+	+	+	1	1	+	IV
PALEOTEMP.	Dactylis glomerata L.	.	+	.	.	+	.	.	+	+	III
EURIMEDIT.	Melica ciliata L.	.	+	+	+	+	.	.	.	.	III
SUBTROP.	Bromus rigidus Roth.	.	+	.	.	+	+	.	.	.	II
STENOMEDIT.	Carlina corymbosa L.	.	.	.	.	+	+	+	.	+	III
	other species										
STENOMEDIT.	Stipa bromoides (L.)Doerfl.	2	+	+	+	1	+	2	1	.	V
STENOMEDIT.	Asparagus acutifolius L.	1	+	+	+	1	1	+	+	+	V
STENOMEDIT.	Rubia peregrina L.	+	.	.	.	.	.	.	.	1	II
STENOMEDIT.	Phillyrea latifolia L.	2	.	.	.	.	.	.	.	.	I
ENDEM.	Chamaecytisus spinescens (Presl.)Rothm	.	.	.	+	+	.	.	.	.	II
EURIMEDIT.	Dorycnium hirsutum (L.)Ser.	.	.	.	.	.	.	.	+	+	II

sociation (Biondi, 1999), which is also based on data coming from one of the surveyed areas (Pirone *et al.*, 1997). We are in the presence of floristically poor communities indicating the relation to *Chamaecytiso-Juniperetum buxetosum sempervirentis*. Two stages are split up within this association, namely: a pioneer stage with *Rhamnus saxatilis* subsp. *infectoria* and a subsequent stage, growing of more developed soils, with *Spartium junceum*. All together these shrub communities are included in clearly thermophylous habitats, as pointed out by the big percentage of Stenomediterranean and Eastern species, and are frequently disturbed and occurs at much lower altitudes.

Dynamically, these communities are found in the *Ostryo-Carpinion orientalis* belt, where it is, however, possible to recognize a habitat with good potentiality

for *Quercion ilicis*, that is to say sites with abundant rocky outcrops that are more favorable to the *Quercus ilex* woodlands, both microclimatically and edaphically.

*JUNIPERO OXYCEDRI-COTINETUM COGGYGRIAE* Biondi, Allegrezza, Guitian 1988 (Tab. III)

In the San Venanzo gorges (Valley of Aterno), *Cotinus coggygria* dominated scrub can be found, which can be included in the *Junipero oxycedri-Cotinetum coggygriae* association, as described by Biondi *et al.* (1988) for the Umbria and Marche Apennine, usually successional stages of *Ostrya carpinifolia* thermophylous woodlands. The same dynamic significance is to be given the vegetation type found in the Aterno Valley, while some more thermophylous communities have been observed in the Gorges of Popoli.

Table III

Altitude (m a.s.l.)	740
Aspect	W
Slope (°)	35
Coverture (%)	80
Vegetation height (cm)	200
Stone (%)	-
Rocky outcrops (%)	-
Surface (mq)	20
	49

	<i>Junipero-Cotinetum coggygriae</i> Biondi, Allegrezza, Guitian 1988	
S-EUROP.-TURAN.	<i>Cotinus coggygria</i> Scop.	2
EURIMEDIT.	<i>Juniperus oxycedrus</i> L. subsp. <i>oxycedrus</i>	+
	<i>Cytisium sessilifolii</i> Biondi 1988, <i>Prunetalia spinosae</i> Tuxen 1952	
	<i>Rhamno-Prunetea</i> Rivas Goday, Borija Carbonell 1961 ex Tuxen 1962	
CENTRO-EUROP.	<i>Coronilla emerus</i> L. subsp. <i>emeroides</i> (Boiss. Et Spruner) Hayek	2
EURIMEDIT.	<i>Lonicera etrusca</i> Santi	1
	<i>Quercetalia pubescenti-petraea</i> Klika 1933 corr. Moravec in Beguin, Theurillat 1984	
	<i>Quercu-Fagetea</i> Br.Bl. et Vlieg 1937 em. Oberdorfer 1992	
S-EUROP.-SUDSIB.	<i>Fraxinus ornus</i> L.	1
SE-EUROP.	<i>Quercus pubescens</i> Willd.	1
EURIMEDIT.	<i>Pistacia terebinthus</i> L.	+
	<i>Quercetalia ilicis</i> Br.Bl. 1936 em. Rivas Martinez 1975	
	<i>Quercetea ilicis</i> Br.Bl. 1947	
STENOMEDIT.	<i>Quercus ilex</i> L.	1
STENOMEDIT.	<i>Phillyrea latifolia</i> L.	1
STENOMEDIT.	<i>Teucrium flavum</i> L.	+
	<i>Cytiso-Satureion montanae</i> Pirone, Tammaro 1997	
	( <i>Cisto-Ericetalia</i> Horvatic 1958, <i>Cisto-Micromerietea</i> Oberd. 1954)	
EURIMEDIT.	<i>Osyris alba</i> L.	1
W-MEDIT.-MONT.	<i>Satureja montana</i> L. subsp. <i>montana</i>	1
OROF. S-EUROP.	<i>Teucrium montanum</i> L.	+
N-MEDIT.-MONT.	<i>Stachys recta</i> L.	+

## Syntaxonomical scheme

- Rhamno cathartici-Prunetea spinosae* Rivas-Goday, Borja-Carbonell 1961 ex Tüxen 1962  
*Prunetalia spinosae* Tüxen 1952  
*Cytision sessilifolii* Biondi in Biondi, Allegrezza, Guitian 1988  
*Chamaecytiso spinescentis-Juniperetum oxycedri* ass. nova  
*buxetosum sempervirentis* subass. nova  
*daphneetosum sericeae* subass. nova  
*Rhamno saxatilis-Paliuretum spina-christi* Biondi 1999  
*Junipero oxycedri-Cotinetum coggygiae* Biondi, Allegrezza, Guitian 1988  
*buxetosum sempervirentis* Biondi, Allegrezza, Guitian 1988  
*osyridetosum albae* Biondi, Allegrezza, Guitian 1988  
*Asparago acutifolii-Osyridetum albae* Allegrezza, Biondi, Formica, Ballelli, 1997

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## References

- AA.VV., 1988. Carta delle Litofacies del Lazio-Abruzzo ed aree limitrofe, con Note illustrative. Quaderni de La Ricerca Scientifica N. 114, Progetto Finalizzato Geodinamica vol. 5, CNR.
- Allegrezza M., Biondi E., Formica E. & Ballelli S., 1997. La vegetazione dei settori calcarei rupestri dell'Italia centrale. *Fitosociologia* 32: 91-120.
- Agostini R., 1955. Rinvenimenti di *Buxus sempervirens* L. lungo le valli del torrente Peglio, del fiume Bussento e del Rio di Casaletto nell'Appennino lucano. *Delpinoa* vol. VIII (t. XXV): 238-285.
- Bannes-Puygiron G. de, 1933. Le Valentinois Meridional. *Comm. SIGMA* 19, Montpellier.
- Banti G., 1954. Stazioni di *Buxus sempervirens* in Val Gravegna (Appennino Genovese). *N. Giorn. Bot. Ital. N.S.* vol. LXI (1): 38-66.
- Biondi E., 1985. Indagine fitosociologica sulle cenosi riferibili alla classe *Quercetea ilicis* presenti sul promontorio del Gargano (Adriatico meridionale). *Not. Fitosoc.* 22: 59-76.
- Biondi E., 1990. Population characteristics of *Juniperus oxycedrus* L. and their importance to vegetation dynamics. *Giorn. Bot. Ital.* vol. 124: 331-337.
- Biondi E., 1999. La vegetazione a *Paliurus spina-christi* Miller: studio delle formazioni adriatiche e revisione sintassonomica. *Doc. Phytosoc. N.S.* vol. XIX: 433-438.
- Biondi E., (1997) 2000. Syntaxonomy of the Mediterranean chamaephytic and nanophanerophytic vegetation in Italy. *Coll. Phytosoc.* XXVII: 123-145.
- Biondi E., Allegrezza M. & Guitian J., 1988. Mantelli di vegetazione del piano collinare dell'Appennino centrale. *Doc. Phytosoc. N.S.* vol. XI: 479-490.
- Biondi E. & Baldoni M.A., 1994. The climate and vegetation of peninsular Italy. *Coll. Phytosoc.* XXIII: 675-721.
- Brullo S., Minissale P. & Spampinato G., 1997. La classe *Cisto-Micromerietea* nel Mediterraneo centrale e orientale. *Fitosociologia* 32: 29-60.
- Chiarugi A., 1950. Le epoche glaciali dal punto di vista botanico. *Acc. Naz. Lincei* 16: 55-109.
- Cutini M., 1996. Sintassonomia e sindinamica dei mantelli di vegetazione dell'Appennino centro-meridionale. Tesi di Dottorato di Ricerca in Scienze Botaniche (VIII ciclo). Università di Roma "La Sapienza": 147 pp.
- Cutini M. & Blasi C., 1995. L'alleanza *Cytision sessilifolii* Biondi *et al.*, 1988 nell'Appennino centro-meridionale. *Coll. Phytosoc.* XXIV: 689-696.
- Cutini M. & Blasi C., 2002. Contributo alla definizione sintassonomica e sindinamica dei mantelli di vegetazione della fascia collinare-submontana dell'Appennino centrale (Italia centrale). *Fitosociologia* 39 (1) suppl. 2: 97-120.
- De Bolòs O. & Vigo J., 1990. Flora dels Països Catalans. Ed. Barcino, vol. II: 927 pp.
- Fenaroli L. & Gambi G., 1976. Alberi. *Dendroflora Italiana*. Museo Tridentino di Scienze Naturali. Trento.
- Francini E. & Messeri A., 1955. L'Isola di Marettimo nell'Arcipelago delle Egadi e la sua vegetazione. *Webbia*, vol. XI: 607-846.
- Hegi G., 1925. *Illustrierte Flora von Mitteleuropa* V: 204-213.
- Mondino G.P., 1989. I querceti a bosso delle Alpi Cozie meridionali (Valli Grana e Maira). *Riv. Piem. St. Nat.* 10: 69-92.

- Montelucci G., 1960. Piante del territorio Cicolano (Lazio orientale-Abruzzo). N. Giorn. Bot. Ital. N.S. vol. LXVII: 342-356.
- Orsomando E., Catorci A. & Cenci C.A., 1992. Aspetti fitogeografici ed ecologici del bosso (*Buxus sempervirens* L.) in Umbria. Studi e Informazioni (IRRES Perugia) 5 (12): 85-104.
- Perdigo' Ariso M.T., 1979. Les lisieres de forets de feuillus dans la region de St.Gervas. Coll. Phytosoc. VIII: 43-49.
- Pignatti S., 1982. Flora d'Italia. Edagricole, Bologna. 3 voll.
- Pirone G., Frattaroli A.R. & Corbetta F., 1997. Vegetazione, cartografia vegetazionale e lineamenti floristici della Riserva Naturale "Sorgenti del Pescara" (Abruzzo - Italia). Comune di Popoli 7: 1-79.
- Pirone G. & Tammara, 1997. The hilly calciophyllous garigues in Abruzzo (Central Apennines - Italy). Fitosociologia 32: 73-90.
- Podani J., 1995. Syn-Tax V. Computer program for data analysis in Ecology and Systematics. UNIDO, Trieste.
- Poldini L., 1989. La vegetazione del Carso Isontino e Triestino. Studio del paesaggio vegetale fra Trieste, Gorizia e i territori adiacenti. Ed. Lint, Trieste.
- Rivas-Goday & Borja-Carbonell, 1961. Estudio de vegetacion y florula del macizo de Gudar y Jabalambre. Ann. Inst. Bot. Cavanilles 19: 1-550.
- Scharfetter R., 1953. Biogeographien von Pflanzen-sippen. Springer-Verlag, Wien.
- Soriano I. & Sebastia' T., 1990. Composicion, distribucion altitudinal y sintaxonomia de los bojedales en la Sierra de Cadi y el Moixerò (Prepirineo Catalan). Fol. Bot. Misc. 7: 115-127.
- Tartaglini N. & Tammara F., 1995. Caratteristiche climatiche dell' Abruzzo. Giorn. Bot. Ital. vol. 129 (2): 281.
- Trinajstic I., 1978. Razred *Paliuretea* Trinajstic, class. nov. In: Sugár (ed.). Vegetacijska karta SR Hrvatske 1: 43.
- Trinajstic I., 1996. Syntaxonomisch-nomenklatorische revision der ostadriatischén vegetation mit *Paliurus* (*Rhamno-Paliurion* Trinajstic, nom.nov.). Ann. Mus. Civ. Rovereto (suppl. II) vol. II: 209-215.
- Tüxen R., 1952. Hecken und Gebüsch. Mitt. geogr. Ges. Hamburg 50. Hamburg.
- Geranium sanguineum* +, *Polygala nicaensis* +, between Pettorano sul Gizio and Rocca Pia, 20-6-1996; rel. 5: *Festuca gr. inops* +, *Leontodon hispidus* +, *Rubia peregrina* +, near S. Pio delle Camere, 26-6-1995; rel. 6: near S. Pio delle Camere, 26-6-1995; rel. 7: *Acinos arvensis* +, *Bupleurum falcatum* +, *Digitalis micrantha* +, near Capestrano, 20-6-1996; rel. 8: Conca del Fucino (between Gioia dei Marsi and Gioia Vecchio), 21-6-1996; rel. 9: *Festuca gr. inops* +, near Capestrano, 5-7-1996; rel. 10: *Arabis turrita* +, *Centaurea rupestris* +, *Peucedanum officinale* +, near Capestrano, 21-6-1996; rel. 11: *Euphorbia myrsinites* +, between Pettorano and Piano di Cinquemiglia, 8-7-1995; rel. 12: between Capo d'Acqua and Forca di Penne, 21-7-1991; rel. 13: *Digitalis micrantha* +, *Helianthemum nummularium* +, *Quercus cerris* +, *Silene italica* +, near Capestrano, 20-6-1996; rel. 14: *Crepis lacera* +, Fucino basins (between Gioia dei Marsi and Gioia Vecchio), 21-6-1996; rel. 15: near Capestrano, 14-6-1994; rel. 16: near Capestrano, 14-6-1994; rel. 17: *Leontodon hispidus* +, between Capestrano and Ofena, 14-6-1994; rel. 18: tra Capestrano e Ofena, 14-6-1994; rel. 19: *Galium lucidum* +, between Navelli and Capestrano, 13-6-1987; rel. 20: *Carex hallerana* +, *Pirus pyraster* +, between Navelli and Capestrano, 13-6-1987; rel. 21: *Linaria purpurea* +, between Navelli and Capestrano, 13-6-1987; rel. 22: *Aster linosyris* +, *Fumana ericoides* +, *Stipa capillata* +, between Pettorano sul Gizio and Rocca Pia, 8-7-1995; rel. 23: *Allium sphaerocephalon* +, *Centaurea rupestris* 1, *Eryngium amethystinum* +, *Pimpinella saxifraga* +, *Convolvulus elegantissima* +, Capestrano, 21-6-1996; rel. 24: between Navelli and Capestrano, 26-6-1995; rel. 25: between Navelli and Capestrano, 26-6-1995; rel. 26: *Loroglossum hircinum* +, *Ruscus aculeatus* 1, *Phleum ambiguum* +, *Stipa bromoides* +, *Stachys gr. germanica* +, Capestrano basin, 20-6-1996; rel. 27: Capestrano basin, 20-6-1996; rel. 28: Capestrano, 14-6-1994; rel. 29: *Festuca gr. inops* +, *Sideritis syriaca* +, *Teucrium poljum* +, *Thymus gr. serphyllum* +, between Raiano and Goriano Sicoli, 9-6-1994; rel. 30: *Ophrys sphaecoides* +, *Urospermum dalechampii* +, Capo d'Acqua, 17-3-1991; rel. 31: *Arbutus unedo* 1, Capo d'Acqua, 17-3-1991; rel. 32: *Stachys recta* +, Capo d'Acqua, 17-3-1991; rel. 33: *Carex hallerana* +, *Ophrys sphaecoides* +, Capo d'Acqua, 17-3-1991; rel. 34: *Galium parisiense* 1, *Hieracium pilosella* +, *Silene vulgaris* +, Capo d'Acqua, 17-3-1991; rel. 35: *Dactylis glomerata* +, *Eryngium campestre* +, *Petrorhagia saxifraga* +, *Silene vulgaris* +, near Pettorano sul Gizio, 20-6-1996; rel. 36: *Aethionema saxatile* +, Capo d'Acqua, 15-6-1994; rel. 37: *Rhamnus alaternus* +, Raiano, loc. Sterpi Rossi, 8-7-1989; rel. 38: Raiano, loc. Sterpi Rossi, 8-7-1989; rel. 39: *Cistus creticus eriocephalus* 1, *Dyanthus sylvestris* +, *Eleoselinum asclepium* +, *Hyssopus officinalis* +, *Teucrium flavum* +, *Stipa bromoides* +, Raiano, loc. Sterpi Rossi, 8-7-1989.

### Locality, data releves and sporadic species

#### Tab. I

Rel. 1: Sierra of Navelli, 26-6-1995; rel. 2: *Leontodon hispidus* +, *Sideritis syriaca* +, *Urospermum dalechampii* +, Sierra of Navelli, 26-6-1995; rel. 3: *Dianthus sylvestris* +, *Hypocrepis comosa* +, *Picris hieracioides* +, *Polygala nicaensis* +, between Pettorano sul Gizio and Rocca Pia, 20-6-1996; rel. 4:

## Tab. II

Rel. 40: *Linum tenuifolium* +, *Micromeria graeca* +, near Castrano, 26-6-1995; rel. 41: Pescara cape, 28-7-1995; rel. 42: *Silene vulgaris* +, *Teucrium chamaedrys* +, Pescara cape, 28-7-1995; rel. 43: *Dianthus ciliatus* +, *Saturaia montana* subsp. *montana* +, Pescara cape, 28-7-1995; rel. 44: *Cistus incanus* +, *Eryngium campestre* +, *Marrubium incanum* +, Pescara cape, 28-7-1995; rel. 45: *Nigella damascena* +, *Stipa capillata* +, Pescara cape, 28-7-1995;

rel. 46: *Convolvulus elegantissimus* +, *Scabiosa columbaria* +, *Silene otites* +, *Stachys recta* +, Pescara cape, 28-7-1995; rel. 47: *Psoralea bituminosa* +, *Quercus ilex* +, Pescara cape, 28-7-1995; rel. 48: *Brachypodium rupestre* +, *Eryngium campestre* +, *Helychrisum italicum* +, *Hypericum perforatum* +, *Picris hieracioides* +, near Pettorano sul Gizio, 20-6-1996.

## Tab. III

Rel. 49 - *Teucrium flavum* +, near Roiano, 8-7-1989.