

Vegetation of the Verdiana River valley in the northern Apennines, Italy

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Resumen: Foggi, B., Lastrucci, L., Papini, P. Vergari, S., Gennai, M., Gervasoni, D., Viciani, D. & Ferretti, G. *La vegetación del valle del río Verdiana, Apeninos septentrionales (Pistoia-Italia Central). Lazaroa 32: 153-178 (2011).*

En el presente trabajo se describe la vegetación del valle del río Verdiana (Pistoia, Apenino Central) mediante el método fitosociológico. Las comunidades vegetales encontradas pertenecen a las siguientes clases: *Montio-Cardaminetea*, *Asplenietea trichomanis*, *Galio-Urticetea*, *Mulgedio-Aconitetea*, *Nardetea strictae*, *Rhamno-Prunetea*, *Salici purpureae-Populetea nigrae* y *Quercu-Fagetea*. En particular, el estudio ha contribuido a la descripción de nuevos sintaxones: *Asplenio viridis-Cystopteridetum fragilis* subass. *saxifragetosum cuneifoliae* subass. nova y *Geranio nodosi-Loniceretum alpigenae* ass. nova, de la cual vienen identificadas dos nuevas subasociaciones: *loniceretosum alpigenae* y *loniceretosum nigrae*. En el estudio se reconocen cinco habitats de interés conservacionístico (Directive 92/43 EEC).

Palabras clave: río Verdiana, Apeninos septentrionales, ripario, matorrales de madreSelva, comunidades megafórbicas.

Abstract: Foggi B., Lastrucci L., Papini P. Vergari S., Gennai M., Gervasoni D., & Ferretti G., *Vegetation of the Verdiana River valley in the northern Apennines, Italy. Lazaroa 32: 153-178 (2011).*

This work describes the vegetation growing in the valley of the Verdiana Stream in the northern Apennines, near Pistoia, Tuscany. The plant communities are reviewed and analysed using a phytosociological methodology and referenced to the following classes: *Montio-Cardaminetea*, *Asplenietea trichomanis*, *Galio-Urticetea*, *Mulgedio-Aconitetea*, *Nardetea strictae*, *Rhamno-Prunetea*, *Salici purpureae-Populetea nigrae* and *Quercu-Fagetea*. Several new taxa are described: *Asplenio viridis-Cystopteridetum fragilis* subass. *saxifragetosum cuneifoliae* subass. nova and *Geranio nodosi-Loniceretum alpigenae* ass. nova subass. *loniceretosum alpigenae* subass. nova and *loniceretosum nigrae* subass. nova. The study identifies five habitats of significant conservation interest (Directive 92/43 EEC).

Keywords: Verdiana River, northern Apennines, riparian vegetation, Lonicera scrubland, megaforbs.

INTRODUCTION

The Verdiana River valley is characterised by vegetation which is scarcely influenced by human activity, having been preserved from excessive sylvicultural exploitation due to the steepness of the terrain and the consequent difficulty of access. This has allowed the particular plant communities to maintain a good state of preservation. Their study is fundamental for determining the best management systems and in order to document and increase our knowledge of plant biodiversity at

the local level. Since the upper Verdiana Valley belongs to SIC Monte Spigolino - Monte Gennaio (code IT5130006) it is characterised as a high-altitude habitat and its preservation value is therefore enhanced.

The Verdiana valley is steep and flanks the river which, like many mountain rivers, cuts deeply into the rock. The riverbed is narrow, with turbulent water flow almost all year round due to the steep gradient along most of the river course. These geomorphological characteristics influence the kinds of vegetation present, which include

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species affected by the presence of running water. The steep slope allows lateral light penetration and heliophilous species to grow even within multilayer forest-like phytocoenoses. This location gives rise to a kind of 'edge effect' which is particularly acute in some forest communities and involves an increase in the internal heterogeneity of the communities, favouring many species with quite different ecological requirements. This creates a high species richness in these communities as well as posing some difficulty for referencing them to the familiar vegetation types, particularly with regard to phytosociological collocation. It was therefore decided in some cases not to formalise the vegetation types identified, as they are not strictly comparable to research carried out under similar conditions but in other areas.

The aim of this paper is to contribute to the phytosociological knowledge of the plant communities in the Verdiana River Valley which are relevant for conservation, and also to contribute to knowledge of other plant communities that thrive in the vicinity of steep mountain streams.

STUDY AREA

GEOGRAPHIC LOCATION

The Verdiana Valley is located in the north of Pistoia province (northern Tuscany). The stream follows a course of 10.5 km running roughly northeast to southwest, and is a tributary of the Lima River. It has a 19 km² catchment which represents 6.2% of the Lima Stream. The Verdiana originates below the Cancellino Pass (1634 m) and joins a branch descending from Monte Cornaccio (1881 m) and another from Monte Gennaio (1813 m). The river headwaters are at the Tyrrhenian/Adriatic watershed and the general course of the valley runs parallel to that of the high Reno Valley, although the two rivers flow in opposite directions.

CLIMATE FEATURES

From the analysis of data from 20 thermometric and 40 pluviometric stations in the Pistoiese



Figure 1. – Study area.

Apennines (source: Ibimet and ARPA EMR) a climate map has been constructed following the Rivas-Martínez bioclimatic classification (RIVAS-MARTÍNEZ, 1995, 2008). The altitude factor creates several climate zones which follow in a sequence from the highest altitude of the Corno alle Scale, where yearly rainfall exceeds 2100 mm and the yearly average temperature is about 3°C, down to the valley floor where the climate has sub-Mediterranean characteristics such as the S Marcello station (625 m) with a mild water shortage in August (36 mm) even though the average yearly temperature is 11.9°C, with January as the coldest month (4.2°C) and July the warmest (20.5°C). In the next highest zone is the Maresca station (1043 m) with a higher rainfall (1997 mm), and an average yearly temperature of 9.4°C (January 1.8°C, August 18.0°C). Table 1 shows the bioclimatic types within the study area.

GEOLOGICAL AND GEOMORPHOLOGICAL FEATURES

The valley is characterised by a major altitude gradient. In little over 10 km, the river drops from an elevation of over 1800 m to 465 m where it flows into the Lima Stream. The erosion of the

Table 1

Bioclimatic belts of the Verdiana valley. For every belt the range of Altitude (m.a.s.l.), Annual precipitation in mm (P) and annual mean temperature (°C) is presented.

Bioclimatic belt	Altitude	P	T
Lower orotemperate, upper hyperhumid climate	> 1700	>2100	3-5
Upper supratemperate, upper hyperhumid climate	1200-1700	2000-2100	5-8
Inferior supratemperate, inferior hyperhumid climate	700-1200	1800-2000	8-11
Upper supratemperate, upper humid climate	< 700	< 1800	>11

valley forms a typical deep V-shape, with steep sides along most of its length. The higher part of the drainage basin splits into two main branches: the branch partially originating in Monte Cornaccio and partially in Monte Gennaio follows an approximately NE-SW course. On its left hydrographic bank, 2.5 km from the source as the crow flies, it is joined by Fosso Selvori which flows from east to west. The Verdiana stream flows on a rocky base made up of quartz-feldspar turbiditic sandstone rocks alternating with silt schists related to the Macigno formation, alternating with marlstone which is typical of the central part of its course.

MATERIALS AND METHODS

The vegetation study is based on 134 relevés carried out along the valley between March 2006 and July 2009, from an altitude of 600 m to the mountain top at 1800 m. The relevés were made following the classic phytosociological methods of the Zurich-Montpellier school (BRAUN-BLANQUET, 1928). The relevés of some vegetation types (woodbine and megaforb communities) are characterised by a particularly high and apparently continuous internal variability, among which it was not easy to find homogenous groups, and they have therefore been analysed by mean cluster analysis performed by the Syntax V software (PODANI, 2002) in order to highlight structures in the data. The cluster analysis was done on a "species x relevés" matrix with abundance-dominance data modified according to VAN DER MAAREL (1979), using the chord distance as the similarity index, and the complete link as the agglomeration method.

RESULTS AND DISCUSSION

EUTROPHIC BEECHWOODS (TABLE 2)

As mentioned above, the sites surveyed are on the banks and in the riverbed. Under these conditions no fine deposits are formed as the current is strong enough to carry huge boulders downhill and the banks are severely eroded, and landslips occur frequently. Since the forest vegetation is often directly influenced by the river, species with different ecologies are often found in the same phytoceonosis. Although homogeneity was always sought in the main site, the microsites produced a notable richness of flora (DI PIETRO, 2009). While larger trees -and to some extent shrubs- are able to withstand flowing water, smaller plants such as grasses are highly affected by these variable and locally changeable conditions, making it difficult to classify them according to classical syntaxonomy. Beech woods are found at elevations below 1000 m on less steep sites where soils of colluvial origin can be found. The floral composition comprises eutrophic species in the association *Cardamino heptaphyllae-Fagetum sylvaticae* Oberd. & Hoffman 1967 (GABELLINI & al., 2006; FOGGI & al., 2008). All the coenoses sampled, however, are affected by surface water flow depending on their proximity to the river. This is indicated by the presence of *Salix caprea*, *S. elaeagnos* and *Petasites albus*.

HORNBEAM WOODS (TABLE 3)

Hornbeam woods can be found near to *Ostrya carpinifolia* woods but at lower altitudes. They are localised in fresh sites but more elevated in comparison with the river. The species composition of

Table 2
Eutrophic beech woodlands
Cardamino heptaphyllae-Fagetum sylvaticae Oberd. & Hoffman 1967
(*Fagion sylvaticae*, *Fagetalia sylvaticae*, *Quercu-Fagetea*)

	1140	1040	930	880
Altitude (m)	1140	1040	930	880
Slope (°)	10	10	10	5
Aspect	W	WNW	N	SW
Surface (m ²)	80	60	60	70
Cover (%)	100	100	100	100
N. relevé	1	2	3	4
Characteristics of association				
<i>Geranium nodosum</i>	+	1	+	+
<i>Cardamine bulbifera</i>	+	1	+	r
<i>Cardamine heptaphylla</i>	.	1	1	r
<i>Euphorbia dulcis</i>	.	+	+	+
<i>Geranium robertianum</i>	.	1	r	.
Ecological variant on running water				
<i>Salix caprea</i>	3	3	.	2
<i>Petasites albus</i>	.	2	3	r
<i>Adenostyles alpina</i>	+	+	1	.
<i>Salix eleagnos</i>	.	1	2	.
<i>Aruncus dioicus</i>	.	1	.	.
Characteristics of higher syntaxa				
<i>Fagus sylvatica</i> subsp. <i>sylvatica</i>	5	4	4	4
<i>Dryopteris filix-mas</i>	+	1	2	.
<i>Sanicula europaea</i>	.	+	r	.
<i>Viola reichenbachiana</i>	.	.	r	r
<i>Festuca heterophylla</i>	.	.	+	2
<i>Oxalis acetosella</i>	.	1	r	.
<i>Lactuca muralis</i>	.	r	.	r
<i>Laburnum alpinum</i>	2	.	.	.
<i>Stellaria nemorum</i> subsp. <i>montana</i>	.	.	1	.
<i>Campanula trachelium</i> subsp. <i>trachelium</i>	.	.	.	1
<i>Ostrya carpinifolia</i>	.	.	1	3
Other species:				
<i>Urtica dioica</i> subsp. <i>dioica</i>	+	r	+	.
<i>Salvia glutinosa</i>	.	+	+	+
<i>Galium mollugo</i> subsp. <i>erectum</i>	.	.	r	1
<i>Gentiana asclepiadea</i>	.	r	r	.
<i>Lonicera alpigena</i> subsp. <i>alpigena</i>	2	1	.	.
<i>Lonicera nigra</i>	+	+	.	.
<i>Hieracium lachenalii</i>	.	r	.	+
<i>Dactylis glomerata</i>	.	r	.	+
<i>Brachypodium sylvaticum</i> subsp. <i>sylvaticum</i>	.	.	.	3

Other species: *Circaea alpina* subsp. *alpina* and *Daphne mezereum* + in 1; *Equisetum arvense* subsp. *arvense*, *Polystichum aculeatum* and *Saxifraga rotundifolia* subsp. *rotundifolia* r, *Anemonoides nemorosa*, *Circaea x intermedia*, *Milium effusum*, *Mnium hornum*, *Polypodium interjectum* and *Sesleria argentea* + in 2; *Angelica sylvestris* subsp. *sylvestris*, *Luzula nivea* y *Ranunculus platanifolius*, *Clematis vitalba*, *Doronicum pardalianches*, *Myrrhis odorata*, *Rubus idaeus* subsp. *idaeus* and *Sorbus aria* +, *Melica uniflora* 1 in 3; *Aegopodium podagraria*, *Dactylorhiza maculata* subsp. *fuchsii*, *Galium laevigatum*, *Scrophularia nodosa* and *Stachys sylvatica* r, *Abies alba*, *Cephalanthera longifolia*, *Crataegus monogyna*, *Cruciata glabra*, *Emerus major*, *Euphorbia cyparissias*, *Fragaria vesca* subsp. *vesca*, *Fraxinus ornus* subsp. *ornus*, *Knautia drymeia*, *Lathyrus vernus* subsp. *vernus* and *Salix purpurea* + in 4. Localities: All from the surroundings of the Verdiana river; geographical coordinates (latitude, longitude) are: 1: 44°05'91", 10°49'23"; 2: 44°05'91", 10°49'23"; 3: 44°05'08", 10°49'06"; 4: 44°04'56", 10°49'06".

Table 3

Hornbeam woodlands

Geranio nodosi-Carpinetum betuli Pedrotti, Ballelli & Biondi 1982*(Carpinion betulii, Fagetalia sylvaticae, Quercio-Fagetea)*

Altitude (m)	680	720	700	610
Slope (°)	35	35	5	45
Aspect	S	SSE	SSE	NE
Surface (m ²)	60	25	150	120
Cover (%)	100	100	100	100
N. relevé	1	2	3	4
Characteristics of association				
<i>Carpinus betulus</i>	5	5	5	4
<i>Geranium nodosum</i>	2	+	+	+
Variant on thin soils with <i>Sesleria argentea</i>				
<i>Sesleria argentea</i>	3	4	3	2
Characteristics of higher syntaxa				
<i>Hedera helix</i>	2	1	1	+
<i>Fraxinus ornus</i> subsp. <i>ornus</i>	+	1	3	1
<i>Festuca heterophylla</i>	1	1	1	2
<i>Lactuca muralis</i>	r	r	+	+
<i>Corylus avellana</i>	3	.	2	3
<i>Melica uniflora</i>	+	.	1	+
<i>Cruciata glabra</i>	+	+	+	.
<i>Fragaria vesca</i> subsp. <i>vesca</i>	r	r	+	.
<i>Solidago virgaurea</i>	r	+	r	.
<i>Crataegus monogyna</i>	1	.	r	.
<i>Euphorbia dulcis</i>	.	+	+	.
<i>Rubus hirtus</i>	r	.	r	.
<i>Campanula trachelium</i>	r	.	.	r
subsp. <i>trachelium</i>				
<i>Sorbus aria</i>	.	r	r	.
<i>Cephalanthera longifolia</i>	.	r	r	.
<i>Castanea sativa</i>	r	.	r	.
<i>Pulmonaria hirta/apennina</i>	.	r	r	.
<i>Asarum europaeum</i>	.	.	3	.
<i>Acer opalus</i> subsp. <i>opalus</i>	2	.	.	.
<i>Acer campestre</i>	.	.	.	2
<i>Galium laevigatum</i>	.	.	.	2
<i>Fagus sylvatica</i> subsp. <i>sylvatica</i>	.	.	2	.
Other species:				
<i>Trochiscanthes nodiflora</i>	+	.	.	1
<i>Hepatica nobilis</i>	+	+	.	.
<i>Asplenium trichomanes</i>	+	r	.	.
<i>Anemonoides nemorosa</i>	.	r	.	+
<i>Polypodium interjectum</i>	+	.	.	r

Other species: *Neottia nidus-avis*, *Cardamine impatiens* subsp. *impatiens* and *Prenanthes purpurea* r, *Adenostyles alpina*, *Angelica sylvestris* subsp. *sylvestris*, *Brachypodium sylvaticum* subsp. *sylvaticum*, *Daphne laureola* and *Laburnum alpinum* +, *Lathyrus vernus* subsp. *vernus* 1 in 1; *Asplenium adiantum-nigrum* subsp. *adiantum-nigrum*, *Campanula persicifolia* subsp. *persicifolia*, *Saxifraga cuneifolia* subsp. *cuneifolia*, *Hieracium murorum* and *Rosa canina* r, *Cyclamen hederifolium* subsp. *hederifolium*, *Emerus major*, *Ilex aquifolium* and *Rubus caesius* + in 2;

Hieracium bifidum, *Knautia drymeia* and *Salvia glutinosa* r, *Geranium robertianum* and *Viola reichenbachiana* + in 3; *Gentiana asclepiadea* r, *Dryopteris filix-mas*, *Gymnocarpium dryopteris*, *Luzula nivea*, *Polystichum aculeatum* and *Saxifraga rotundifolia* subsp. *rotundifolia* + in 4.

Localities: All from the surroundings of the Verdiana river; geographical coordinates (latitude, longitude) are: 1: 44°04'06", 10°47'59"; 2: 44°03'59", 10°47'48"; 3: 44°04'16", 10°48'16"; 4: 44°04'17", 10°48'22".

the herbaceous layer is very similar to that of the beech woods. The dominance of hornbeam in the tree layer leads us to ascribe our coenoses to the association *Geranio nodosi-Carpinetum betuli* described by Pedrotti, Ballelli & Biondi 1982 for the ancient lake waterbasin of Gubbio (PEDROTTI & al., 1982), and not to the association *Carpino-Coryletum* Ballelli, Biondi, Pedrotti 1980 which groups shrub coenoses dominated by *Corylus avellana*, whose characteristic species are not present in our stands (BALLELLI & al., 1980). Here, the association differs from the typical one due to the presence of *Sesleria argentea*, which configures a variant of superficial soils. AS PIRONE (2000) already pointed out for Abruzzo, in the *Geranio nodosi-Carpinetum betuli* association, *Corylus avellana* is well represented in the shrub layer. From the table we can see a group of typical higher-altitude species due to the very deep valley that severely limits access by sunlight and to the connection with species typical of higher-altitude coenoses such as: *Gymnocarpium dryopteris*, *Lathyrus vernus*, *Laburnum alpinum*, *Polystichum aculeatum*.

OSTRYA CARPINIFOLIA WOODS (TABLE 4)

Black-hornbeam woods are frequently found in southern exposures and on medium to gentle slopes, but not always on fully-developed soils formed by deep river sediments covered by thin layers of soil. From the phytosociological point of view they show affinities with the woods referred to by GABELLINI & al. (2006) as a variant of *Roso caninae-Ostyetum*, with *Sesleria argentea* and *Hepatica nobilis*. The floral composition of these woods is in an intermediate position to several syntaxa of superior rank, and in particular among the woods referred to by BLASI & al. (2004) such as *Campa-*

Table 4
 Black hornbeam woodlands
Roso caninae-Ostryetum carpinifoliae
 (Barbero & Bono 1971) Ubaldi 1995
 (*Crataego laevigati-Quercion cerridis*, *Quercetalia pubescenti-petreae*, *Querco-Fagetea*)

	840	960	880	880	1000	870	850	990
Altitude (m)	840	960	880	880	1000	870	850	990
Slope(°)	<5	<5	<5	<5	-	<5	10	10
Aspect	S	S	SSW	S	-	SSW	W	W
Surface (m ²)	75	50	18	80	15	40	45	30
Cover (%)	100	100	100	100	100	90	80	100
N relevé	1	2	3	4	5	6	7	8
Characteristics and differentials of association								
<i>Ostrya carpinifolia</i>	5	4	5	5	5	5	4	4
<i>Sesleria argentea</i>	4	+	+	.	4	.	+	1
<i>Corylus avellana</i>	1	.	3	.	.	.	.	1
<i>Cephalanthera longifolia</i>	+	.	+	.	1	+	.	+
<i>Campanula trachelium</i> subsp. <i>trachelium</i>	.	r	.	.	.	r	.	r
<i>Dryopteris filix-mas</i>	.	.	.	.	r	+	+	+
<i>Hepatica nobilis</i>	.	+	.	.	.	.	.	.
Ecological variant on running water								
<i>Petasites albus</i>	.	.	.	.	.	3	5	4
<i>Oxalis acetosella</i>	.	.	.	.	.	+	+	+
<i>Aruncus dioicus</i>	.	.	r	.	.	1	.	+
<i>Urtica dioica</i> subsp. <i>dioica</i>	.	.	.	.	.	.	+	r
<i>Adenostyles alpina</i>	.	.	.	.	.	+	r	.
<i>Equisetum arvense</i> subsp. <i>arvense</i>	.	.	.	.	.	r	+	.
<i>Solanum dulcamara</i>	.	.	.	.	.	.	+	r
Characteristics of higher syntaxa								
<i>Festuca heterophylla</i>	3	3	3	3	1	2	1	3
<i>Fraxinus ornus</i> subsp. <i>ornus</i>	2	1	.	1	2	.	r	+
<i>Fagus sylvatica</i> subsp. <i>sylvatica</i>	.	3	1	1	2	.	.	.
<i>Geranium nodosum</i>	.	+	+	+	.	+	+	1
<i>Fragaria vesca</i> subsp. <i>vesca</i>	+	r	r	+	.	r	.	+
<i>Hedera helix</i>	1	r	.	.	+	r	.	r
<i>Sorbus aria</i>	.	.	r	+	.	+	.	1
<i>Rubus hirtus</i>	+	.	.	.	.	+	+	+
<i>Cruciata glabra</i>	.	+	+	r	.	.	.	+
<i>Viola reichenbachiana</i>	.	r	.	r	r	.	.	r
<i>Hieracium gr. murorum</i>	r	.	.	+	r	.	.	r
<i>Lathyrus vernus</i> subsp. <i>vernus</i>	+	1	1	.	.	.	.	.
<i>Solidago virgaurea</i>	r	+	+	.	.	.	.	.
<i>Melica uniflora</i>	.	1	r	.	.	.	r	.
<i>Crataegus monogyna</i>	+	.	.	+	r	.	.	.
<i>Luzula nivea</i>	.	.	+	1	.	+	.	.
<i>Emerus major</i>	.	.	3	r	+	.	.	.
<i>Gentiana asclepiadea</i>	.	.	.	+	.	+	.	+
<i>Laburnum anagyroides</i> subsp. <i>anagyroides</i>	1	.	.	1	.	r	.	.
<i>Geranium robertianum</i>	.	.	.	.	.	+	+	+
<i>Lactuca muralis</i>	.	.	.	.	.	r	r	r
<i>Cardamine impatiens</i> subsp. <i>impatiens</i>	.	.	.	.	.	r	r	+
<i>Euphorbia dulcis</i>	.	+	.	+	.	.	.	.
<i>Pulmonaria hirta/apennina</i>	+	r	.	.	.	.	.	.
<i>Cardamine bulbifera</i>	.	.	.	+	.	.	.	r
<i>Cardamine heptaphylla</i>	.	.	.	.	.	r	.	+

N relevé	1	2	3	4	5	6	7	8
<i>Castanea sativa</i>	.	.	.	r	r	.	.	.
<i>Epipactis helleborine</i>	r	.	.	.	.	r	.	.
<i>Laburnum alpinum</i>	.	.	.	.	3	.	.	.
Other species								
<i>Salix eleagnos</i>	1	.	1	2	.	1	.	3
<i>Dactylis glomerata</i>	+	.	+	+	.	+	+	.
<i>Salvia glutinosa</i>	.	.	.	+	r	1	+	.
<i>Galium mollugo</i> subsp. <i>erectum</i>	+	.	.	+	.	+	r	.
<i>Knautia drymeia</i>	.	.	+	+	.	.	r	r
<i>Brachypodium sylvaticum</i> subsp. <i>sylvaticum</i>	.	.	.	3	.	+	+	.
<i>Salix caprea</i>	1	.	.	1	.	.	.	.
<i>Juniperus communis</i>	.	.	.	+	1	.	.	.
<i>Dactylorhiza maculata</i> subsp. <i>fuchsii</i>	.	.	1	.	.	.	.	+
<i>Circaea x intermedia</i>	.	.	.	.	.	+	+	.
<i>Hieracium bifidum</i>	.	+	+	.	.	.	.	.
<i>Vicia cracca</i>	.	.	+	.	r	.	.	.

Other species: *Melittis melissophyllum* subsp. *melissophyllum* and *Polystichum aculeatum* r in 1; *Anemonoides nemorosa*, *Glechoma hederacea* and *Polypodium cambricum* *Pteridium aquilinum* subsp. *aquilinum* r, *Corallorhiza trifida* + and *Asarum europaeum* 1 in 2; *Calamintha grandiflora*, *Carduus carlinifolius* subsp. *carlinifolius*, *Lotus corniculatus*, *Valeriana tripteris* and *Carex remota* r in 3, *Cirsium erisithales* and *Pyrola minor* + in 3; *Epipactis persica* subsp. *gracilis*, *Euphorbia cyparissias*, *Lapsana communis* subsp. *communis* and *Trifolium pratense* r, *Agrostis capillaris*, *Campanula persicifolia* subsp. *persicifolia*, *Daphne mezereum*, *Pseudotsuga menziesii* and *Salix purpurea* + in 4; *Listera ovata* and *Platanthera chlorantha* 1 in 5; *Aegopodium podagraria*, *Clematis vitalba* and *Cardamine hirsuta* r, *Athyrium filix-femina*, *Chaerophyllum hirsutum* and *Mnium hornum* + in 7; *Acer pseudoplatanus*, *Cephalanthera damasonium*, *Galium mollugo* subsp. *erectum*, *Polypodium interjectum* and *Stellaria nemorum* subsp. *montana* r, *Angelica sylvestris* subsp. *sylvestris*, *Carex pendula* and *Conocephalum conicum* + in 8.

Localities: All from the surroundings of the Verdiana river; geographical coordinates (latitude, longitude) are: 1: 44°04'57", 10°48'59"; 2: 44°05'26", 10°49'08"; 3: 44°05'03", 10°49'04"; 4: 44°05'03", 10°49'04"; 5: 44°05'28", 10°49'21"; 6: 44°05'07", 10°49'00"; 7: 44°05'02", 10°49'00"; 8: 44°05'27", 10°49'18".

nulo-Ostryenion Ubaldi (1986) 1995 and to the woods that UBALDI (2003) refers to as *Laburno-Ostryenion* (Ubaldi 1986) Blasi, Di Pietro & Filesi 2004. Both these suballiances belong to *Ostryo-Carpinion orientalis*, which suggests acceptance of the presence of this alliance in the area under examination. We concur with ARRIGONI (1998) in considering that the characteristic species of the *Ostryo-Carpinion orientalis* are not present, at least in north-western Tuscany. Accordingly, we prefer to assign this *Ostrya* dominated forest to the alliance *Crataego-Quercion cerridis* Arrigoni 1997 (ARRIGONI, 1997), recently reconsidered by DI PIETRO & al. (2010). In the herbaceous layer we found some species which can be referred to the order *Fagetalia sylvaticae* and indicate the passage to beech wood. As in the case of beech woods, there are certain aspects that show a remarkable number of species linked to light and water-flow due to proximity to the river. The block of relevés 6-8, for

example, clusters species of forest margins and megaforbs such as *Petasites albus*, *Aruncus dioicus* and *Adenostyles alpina* that can be found here due to the light and the effect of running water.

SHRUBBY RIPARIAN WILLOW GROVES (TABLE 5)

Starting from the minimum flow riverbed there are mainly coenoses with willow forming the first band of woody vegetation which is not generally able to develop into new coenoses due to frequent disturbance by flooding.

The willow groves along the Verdiana are dominated by *Salix elaeagnos*, sometimes found in association with *S.purpurea*. They have been referred to the association *Salicetum incano-purpureae* Sillinger 1933. As indicated by PIRONE (2000) for Abruzzo, the differences between *Salicetum incano-purpureae* Sillinger 1933 (= *Salicetum elaeagni* Hag 1916 ex Jenig 1955) and

Table 5
 Riparian willow open woodlands *Salicetum incano-purpureae* Sillinger 1933
Salicetum incano-purpureae subass. *petasitetosum hybridi* Oriolo & Poldini 2002
 (*Salicion incanae*, *Salicetalia purpureae*, *Salici purpureae-Populetea nigrae*)

Altitude (m)	580	580	580	580	800	850	850	800
Slope (°)	-	-	-	-	-	-	-	-
Aspect	-	-	-	-	-	-	-	-
Surface (m ²)	45	35	35	25	60	120	40	80
Cover (%)	100	100	80	100	90	90	90	100
N relevé	1	2	3	4	5	6	7	8
Characteristics and differentials of assoc. & higher syntaxa								
<i>Salix eleagnos</i>	5	5	5	5	4	4	4	5
<i>Salix purpurea</i> subsp. <i>purpurea</i>	.	.	.	1	2	2	3	.
<i>Solanum dulcamara</i>	+	1	.	.	.	r	.	r
<i>Carex pendula</i>	.	.	.	.	1	2	1	+
<i>Saponaria officinalis</i>	r	1	.	+	.	.	.	.
<i>Carex remota</i>	.	.	.	.	.	1	.	+
<i>Circaea lutetiana</i> subsp. <i>lutetiana</i>	.	.	.	.	.	r	.	1
<i>Circaea x intermedia</i>	.	.	.	.	.	.	+	+
<i>Angelica sylvestris</i> subsp. <i>sylvestris</i>	.	.	.	r	.	.	.	r
<i>Populus nigra</i>	.	.	r	1	.	.	.	.
<i>Salix triandra</i> s.l.	.	.	.	.	.	2	.	.
<i>Alnus incana</i>	.	.	.	1	.	.	.	.
<i>Salix alba</i>	.	.	.	.	.	1	.	.
Differentials of subass.								
<i>Eupatorium cannabinum</i> subsp. <i>cannabinum</i>	+	+	+	+	r	.	+	r
<i>Petasites hybridus</i> subsp. <i>hybridus</i>	.	.	.	.	.	.	+	1
<i>Hygrophilous species</i>								
<i>Galium mollugo</i> subsp. <i>erectum</i>	+	+	+	+	r	.	+	r
<i>Equisetum arvense</i> subsp. <i>arvense</i>	.	.	.	.	+	4	1	+
<i>Mentha aquatica</i> subsp. <i>aquatica</i>	.	.	2	+	+	.	3	.
<i>Artemisia vulgaris</i>	r	.	.	.	r	.	+	.
<i>Ranunculus repens</i>	.	.	.	.	+	.	r	r
<i>Urtica dioica</i> subsp. <i>dioica</i>	.	r	.	.	.	+	.	r
<i>Barbarea vulgaris</i> subsp. <i>vulgaris</i>	.	.	r	.	.	.	.	r
<i>Epilobium hirsutum</i>	.	.	+	r	.	.	.	.
<i>Lysimachia punctata</i>	.	.	.	.	+	.	r	.
<i>Myosotis scorpioides</i> subsp. <i>scorpioides</i>	.	.	.	.	.	.	r	r
<i>Nasturtium officinale</i> subsp. <i>officinale</i>	.	.	.	.	.	r	r	.
<i>Petasites albus</i>	.	r	.	1	.	.	.	.
<i>Arctium lappa</i>	.	.	.	.	.	.	.	3
Other species								
<i>Cardamine hirsuta</i>	.	.	.	.	.	r	.	r
<i>Cardamine impatiens</i> subsp. <i>impatiens</i>	.	.	.	.	.	r	.	r
<i>Clematis vitalba</i>	1	1	+	1	.	.	.	+
<i>Cruciata laevipes</i>	.	.	.	r	.	.	.	r
<i>Fraxinus ornus</i> subsp. <i>ornus</i>	.	+	.	.	.	.	.	r
<i>Geranium nodosum</i>	.	r	.	.	.	.	.	r
<i>Geranium robertianum</i>	.	r	.	.	.	.	.	r
<i>Impatiens noli-tangere</i>	.	.	.	.	.	.	.	2
<i>Lactuca muralis</i>	.	+	.	r	.	.	.	.
<i>Melica uniflora</i>	.	+	.	.	.	.	.	r
<i>Prunella vulgaris</i> subsp. <i>vulgaris</i>	.	.	.	+	+	.	.	r
<i>Salvia glutinosa</i>	1	+	.	.	.	.	.	+

N relevé	1	2	3	4	5	6	7	8
<i>Scrophularia nodosa</i>	.	r	r	.	.	+	.	+
<i>Stachys sylvatica</i>	1	1	+
<i>Tussilago farfara</i>	.	.	r	.	+	.	1	.
<i>Vicia cracca</i>	.	r	.	.	.	.	r	.

Other species: *Bromus ramosus* r in 1; *Chaerophyllum temulum*, *Euphorbia cyparissias*, *Galeopsis tetrahit*, *Lathyrus sylvestris* subsp. *sylvestris* and *Silene latifolia* subsp. *alba* r, *Helleborus foetidus* subsp. *foetidus*, *Ostrya carpinifolia* and *Schedonorus giganteus* + in 2; *Hypericum maculatum* subsp. *maculatum* r in 3; *Hedera helix* and *Salix caprea* r in 4; *Taraxacum officinale* r, *Inula conyzae* + in 5; *Plantago major* s.l. r in 6; *Achillea millefolium* s.l., *Crataegus monogyna*, *Digitalis lutea* subsp. *australis*, *Hypericum perforatum*, *Lapsana communis* subsp. *communis*, *Persicaria lapathifolia* subsp. *lapathifolia*, *Rumex sanguineus*, *Scrophularia auriculata* subsp. *auriculata*, *Symphytum tuberosum* subsp. *angustifolium*, *Trifolium pratense* subsp. *pratense*, *Valeriana tripteris* s.l. and *Viola reichenbachiana* r, *Agrostis capillaris* and *Cirsium oleraceum* +, *Poa nemoralis* subsp. *nemoralis* and *Rosa canina* s.l. 1 in 7; *Alchemilla glabra*, *Chaerophyllum hirsutum*, *Dactylis glomerata*, *Festuca heterophylla*, *Fragaria vesca* subsp. *vesca*, *Poa trivialis* and *Sambucus nigra* r, *Laburnum alpinum* +, *Alnus cordata* 1 in 8.

Localities: All from the surroundings of the Verdiana river; geographical coordinates (latitude, longitude) are: 1: 44°04'10", 10°47'00"; 2: 44°04'10", 10°47'00"; 3: 44°04'10", 10°47'00"; 4: 44°04'10", 10°47'00"; 5: 44°04'36", 10°48'54"; 6: 44°04'53", 10°49'02"; 7: 44°04'53", 10°49'02"; 8: 44°04'46", 10°48'54".

Saponario-Salicetum purpureae (Br.-Bl., 1930) Tchou 1946 are that the first can be found on elevated, steep mountainous terrain on sandy/gravelly substrates and with boulders of various sizes, while the second is usually located at lower elevations (400-500 m) mainly on silty, sandy or sometimes gravelly alluvial soils. In our surveys a mixture of species was observed which does not allow identification of all aspects of the *Salicetum incano-purpureae* association described by PIRONE (2000), ORIOLO & POLDINI (2002) or ŠILC (2003). Nevertheless, at least two surveys include *Petasites hybridus*, *Eupatorium cannabinum* and *Cirsium oleraceum* and can be ascribed to the subassociation *petasitetosum hybridi* ORIOLO & POLDINI 2002 typical of a mesophyllous mesophilous environment.

WHITE ALDER RIPARIAN WOODLANDS (TABLE 6)

Some groves dominated by white alder (*Alnus incana* Moench) have been sampled at an elevation of about 600 m. These phytocoenoses can be referred to the association *Alnetum incanae* Lüdi belonging to the alliance *Alion incanae* (= *Alno-Padion* Knapp 1942; *Alno-Ulmion* Br.-Bl. & Tüxen 1943). The classification of RIVAS-MARTÍNEZ & al. (2002) is here followed to determine the syntaxonomic position, although its collocation is still complicated and somewhat equivocal

(BLASI & FRONDONI, 1998; BIONDI & al., 2004; CESCHIN & SALERNO, 2008; LANDI & ANGIOLINI 2010; DI PIETRO & al., 2010). In many relevés *Fraxinus ornus* is present in many relevés, making these alder groves different from those in the Lima Valley (ARRIGONI & PAPINI, 2003) at higher elevations (900-1200 m) where *Fraxinus excelsior* is found. The Verdiana alder groves are on reasonably well-lit gentle slopes at the foot of steep, sometimes almost vertical hillsides. In these circumstances it is possible for material of colluvial origin, water and mineral nutrients to accumulate in considerable quantities. Under these ecological conditions many nitrophilous, perennial species and several species of *Fagetalia* have been noted in the herbaceous layer. In the last two relevés in the table, *Salix elaeagnos* indicates a degree of continuity with the shrubby willow groves of the riparian zone.

LINEAR MANTLE FORMATION WITH WOODBINE (TABLE 7)

Outside the beech woods there are phytocoenoses dominated by *Lonicera nigra*, in shadier locations, and *Lonicera alpigena* in better-lit stands. These two species are local and quite rare in Tuscany. These shrub groves have not been fully studied because of their rarity, not only in Tuscany but also more widely in Italy and even in Europe.

Table 6
 White alder riparian woodlands
Alnetum incanae Lüdi 1921
 (*Alnion incanae*, *Populetales albae*, *Salici purpureae*-*Populetea nigrae*)

	620	620	620	690	610	600	590
Altitude (m)	620	620	620	690	610	600	590
Slope (°)	<5	15	5	-	5	<5	<5
Aspect	SW	SSW	SSE	SSE	W	NW	S
Surface (m ²)	100	40	75	80	40	100	80
Cover (%)	90	100	100	100	100	100	90
N relevé	1	2	3	4	5	6	7
Characteristic species of association and higher syntaxa							
<i>Alnus incana</i>	5	5	4	4	5	4	3
<i>Circaea x intermedia</i>	+	+	+	.	.	+	.
<i>Stellaria nemorum</i> subsp. <i>montana</i>	+	+	.	+	1	.	.
<i>Solanum dulcamara</i>	.	r	1	.	.	r	+
<i>Carex pendula</i>	.	.	.	.	+	.	+
<i>Brachypodium sylvaticum</i> subsp. <i>sylvaticum</i>	.	.	+	.	+	1	.
<i>Stachys sylvatica</i>	.	+	r	1	.	.	.
<i>Salix eleagnos</i>	.	.	.	.	.	3	2
<i>Rubus caesius</i>	.	.	1	.	.	.	.
<i>Salix purpurea</i> subsp. <i>purpurea</i>	.	.	.	.	.	.	1
<i>Salix alba</i>	.	.	.	.	.	.	1
<i>Circaea lutetiana</i> subsp. <i>lutetiana</i>	.	.	r	.	.	.	.
Other species							
<i>Geranium robertianum</i>	1	1	+	+	+	1	+
<i>Cardamine heptaphylla</i>	+	+	+	+	+	+	.
<i>Fraxinus ornus</i> subsp. <i>ornus</i>	1	4	4	2	1	2	.
<i>Melica uniflora</i>	3	3	4	1	2	2	.
<i>Salvia glutinosa</i>	1	2	1	.	1	+	+
<i>Galium mollugo</i> subsp. <i>erectum</i>	+	1	1	.	+	+	1
<i>Clematis vitalba</i>	.	3	2	.	1	2	+
<i>Hedera helix</i>	1	2	1	+	1	.	.
<i>Lactuca muralis</i>	.	r	+	+	.	+	+
<i>Lamium galeobdolon</i>	1	1	.	r	2	1	.
<i>Rosa canina</i> s.l.	.	.	r	+	r	r	+
<i>Cornus sanguinea</i> s.l.	r	.	.	2	1	+	.
<i>Geranium nodosum</i>	.	+	+	+	+	.	.
<i>Geum urbanum</i>	+	r	.	1	r	.	.
<i>Sambucus nigra</i>	2	.	1	2	1	1	.
<i>Stellaria media</i> subsp. <i>media</i>	1	2	1	.	2	1	.
<i>Eupatorium cannabinum</i> subsp. <i>cannabinum</i>	.	.	1	.	+	+	3
<i>Galium aparine</i>	.	+	1	r	1	.	.
<i>Ostrya carpinifolia</i>	1	.	2	.	.	1	3
<i>Carpinus betulus</i>	.	1	.	2	.	2	.
<i>Acer pseudoplatanus</i>	1	.	.	.	.	+	r
<i>Campanula trachelium</i> subsp. <i>trachelium</i>	.	.	.	.	r	r	r
<i>Cardamine bulbifera</i>	.	.	.	r	r	r	.
<i>Cardamine impatiens</i> subsp. <i>impatiens</i>	+	r	.	r	.	.	.
<i>Arabis turrata</i>	.	r	.	.	.	r	r
<i>Calamagrostis arundinacea</i>	+	.	.	.	.	+	+
<i>Chaerophyllum temulum</i>	+	+	.	r	.	.	.
<i>Corylus avellana</i>	1	.	1	2	.	.	.
<i>Crataegus monogyna</i>	1	.	.	1	1	.	.
<i>Petasites albus</i>	.	.	1	1	1	.	.

N relevé	1	2	3	4	5	6	7
<i>Rubus hirtus</i>	r	.	.	3	+	.	.
<i>Urtica dioica</i> subsp. <i>dioica</i>	+	.	r	2	.	.	.
<i>Aegopodium podagraria</i>	+	.	.	.	+	.	.
<i>Alnus cordata</i>	1	1
<i>Angelica sylvestris</i> subsp. <i>sylvestris</i>	.	.	r	.	.	.	+
<i>Arctium lappa</i>	.	.	1	.	+	.	.
<i>Asarum europaeum</i>	.	.	.	1	.	+	.
<i>Bromus ramosus</i>	.	.	+	.	.	.	+
<i>Dactylis glomerata</i>	+	r
<i>Dryopteris filix-mas</i>	1	.	.	.	r	.	.
<i>Equisetum arvense</i> subsp. <i>arvense</i>	+	2
<i>Hypericum perforatum</i>	.	.	r	.	.	.	+
<i>Mentha aquatica</i> subsp. <i>aquatica</i>	+	.	+
<i>Robinia pseudacacia</i>	+	r
<i>Saponaria officinalis</i>	1	+	.
<i>Scrophularia auriculata</i> subsp. <i>auriculata</i>	+	r
<i>Scrophularia nodosa</i>	.	+	+
<i>Silene latifolia</i> subsp. <i>alba</i>	r	+	.
<i>Castanea sativa</i>	.	.	.	2	.	.	.
<i>Galeopsis tetrahit</i>	1	.
<i>Helleborus foetidus</i> subsp. <i>foetidus</i>	.	.	.	1	.	.	.
<i>Laburnum anagyroides</i> subsp. <i>anagyroides</i>	.	.	2	.	.	.	.
<i>Lysimachia punctata</i>	1	.
<i>Mentha suaveolens</i> subsp. <i>suaveolens</i>	1
<i>Petasites hybridus</i> subsp. <i>hybridus</i>	1	.	.
<i>Prunus spinosa</i> subsp. <i>spinosa</i>	1	.	.
<i>Tussilago farfara</i>	2

Other species: *Agrostis stolonifera* r, *Astragalus glycyphyllos* and *Vicia cracca* + in 2; *Aquilegia vulgaris*, *Fragaria vesca* subsp. *vesca*, *Helleborus viridis* subsp. *viridis*, *Hieracium* gr. *murorum*, *Medicago lupulina* and *Trifolium pratense* subsp. *pratense* r, *Prenanthes purpurea* + in 3; *Polygonatum multiflorum*, *Polystichum setiferum* and *Rubus idaeus* subsp. *idaeus* r, *Athyrium filix-femina*, *Hypericum androsaemum*, *Acer opalus* subsp. *obtusatum* and *Trochiscanthus nodiflora* + in 4; *Alliaria petiolata* r, *Humulus lupulus* and *Pulmonaria hirta/apennina* + in 5; *Artemisia vulgaris*, *Ranunculus repens*, *Teucrium scorodonia*, *Viola reichenbachiana* r, *Euphorbia dulcis* and *Knautia drymeja* + in 6; *Artemisia verlotiorum*, *Cirsium vulgare*, *Daucus carota* s.l., *Lathyrus sylvestris* subsp. *sylvestris*, *Melilotus alba* and *Populus tremula* r, *Barbarea vulgaris* subsp. *vulgaris*, *Dipsacus fullonum*, *Epilobium hirsutum*, *Heracleum sphondylium* s.l., *Juncus inflexus*, *Lapsana communis* subsp. *communis*, *Picris hieracioides* s.l., *Salix caprea* and *Schedonorus giganteus* + in 7. Localities: All from the surroundings of the Verdiana river; geographical coordinates (latitude, longitude) are: 1: 44°04'08", 10°47'24"; 2: 44°04'08", 10°47'24"; 3: 44°04'08", 10°47'24"; 4: 44°04'16", 10°48'13"; 5: 44°04'08", 10°47'18"; 6: 44°04'08", 10°47'12"; 7: 44°04'09", 10°47'05".

The cluster analysis (Figure 2) shows two principal clusters of relevés, each characterised by the dominance of one of the two species of *Lonicera*. The two groups show a set of species in common such as *Geranium nodosum*, *Dryopteris filix-mas*, *Polystichum aculeatum*, *Geranium robertianum* and *Saxifraga rotundifolia*, which are typical of the herbal synusia of the humid beech woods of the area, in sites with rocks and often near streams. Interestingly, many of these species can often be found in black and white alder groves.

Lonicera alpigena and *L. nigra* are species found in beech and fir woods, and in shady environments that may include gorges, or inside megaforb vegetation (RAMEAU & al., 1993). A significant number are included in the association *Lonicera alpigena*-*Fagetum* Oberd. in Oberd. et Th. Müller 1984, as we found in WILLNER (2002); however we cannot use this syntaxa due to the dominance of the two scrubby *Lonicera* species. In the phytocoenoses we recorded alongside these beech wood species, there were several species

Table 7
 Linear mantle formation with woodbine
Geranio nodosi-Loniceratum alpiginae ass. *nova hoc loco* (1-16)
Geranio nodosi-Loniceratum alpiginae loniceretosum nigrae subass. nova hoc loco (17-25)
 (*Sambucetalia racemosae, Rhanno-Prunetea*)

Altitude (m)	1140	880	900	860	950	1100	1120	1075	1110	900	900	890	890	860	1150	1150	1095	1115	900	1080	900	880	890			
Slope (°)	50	60	40	20	50	45	50	30	40	25	45	60	40	60	40	60	60	50	40	60	50	45	45	30		
Aspect	N	NW	NE	W	SSW	NW	N	NW	N	N	N	NW	N	NE	NW	NE	NW	NW	NE	S	NNW	W	SSW			
Surface (m ²)	15	5	20	10	10	8	5	8	8	10	4	5	7	12	4	8	10	2	6	10	5	4	3	5		
Cover (%)	80	90	75	80	70	70	90	90	50	75	75	70	70	70	65	70	90	66	90	68	70	70	50			
Number in Cluster	1	14	9	16	2	3	4	5	6	8	10	11	7	12	13	15	17	24	21	18	20	23	19	22	25	
N relevé	1	2	3	4	5	6	7	8	9*	10	11	12	13	14	15	16	17	18	19	20	21	22	23*	24	25	
Characteristics of <i>Geranio-Loniceratum loniceretosum alpiginae</i>																										
<i>Dryopteris filix-mas</i>	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Lonicera alpigina</i> subsp. <i>alpigina</i>	4	5	3	3	3	4	4	5	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3
<i>Geranium nodosum</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Polystichum aculeatum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Geranium robertianum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Saxifraga rotundifolia</i> subsp. <i>rotundifolia</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Differentials of <i>loniceretosum nigrae</i>	2	+	2	3	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lonicera nigra</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Adenostyles alpina</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Athyrium filix-femina</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Woodland species	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<i>Stellaria nemorum</i> subsp. <i>montana</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Urtica dioica</i> subsp. <i>dioica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Oxalis acetosella</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lactuca muralis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Anemonoides nemorosa</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Euphorbia dulcis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species of wet edge	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cardamine impatiens</i> subsp. <i>impatiens</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Circaea alpina</i> subsp. <i>alpina</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Chaerophyllum hirsutum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lamium galeobdolon</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Petasites albus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Aruncus dioicis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

N relevé	1	2	3	4	5	6	7	8	9*	10	11	12	13	14	15	16	17	18	19	20	21	22	23*	24	25	
Species from rocky wet habitat																										
<i>Cystopteris fragilis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	r	.	.	.	.	r	.	.
<i>Asplenium trichomanes s.l.</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Asplenium viride</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Characteristics of higher syntaxa																										
<i>Rubus idaeus</i> subsp. <i>idaeus</i>	r	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
<i>Daphne mezereum</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other species																										
<i>Agrostis capillaris</i>	.	+	.	.	.	.	.	.	r	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
<i>Fagus sylvatica</i> subsp. <i>sylvatica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Epipactis</i> sp.	.	.	r	.	.	.	.	.	.	.	r	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.
<i>Sesleria argentea</i>	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Other species: *Festuca heterophylla* r in 6, 24 and 25; *Luzula nivea* r in 1, 1 in 5; *Cardamine heptaphylla* + in 4 and 5; *Cardamine bulbifera* + in 4 and 13; *Impatiens noli-tangere* + in 4 and 17; *Doronicum pardalianches* + in 1, r in 20; *Angelica sylvestris* subsp. *sylvestris* r in 16, + in 24; *Gentiana asclepiadea* r in 17, + in 24; *Viola reichenbachiana* + in 24 and 25. *Cardamine monogyna* and *Polygonatum multiflorum* r, *Sorbus aucuparia* subsp. *aucuparia* 1 in 4; *Emerus major* and *Galium aparine* r, *Hedera helix s.l.*, *Laserpitium latifolium* and *Melica uniflora* + in 5; *Polygonatum interjectum* + in 14; *Imperatoria ostruthium* and *Myosotis sylvatica* subsp. *sylvatica* r in 16; *Epilobium montanum* and *Phyteuma scorzonerifolium* r, *Salvia glutinosa* + in 17; *Campanula trachelium* subsp. *trachelium* r, *Calamagrostis arundinacea* 1 in 19; *Veronica urticifolia* + in 21; *Carex remota* 1 in 22; *Cruciatia laevipes*, *Equisetum arvense* subsp. *arvense*, *Euphorbia cyparissias*, *Senecio germanicus* and *Valeriana tripteris* r in 24; *Prenanthes purpurea* and *Rubus hirtus* r in 25.

Localities: All from the surroundings of the Verdiana river; geographical coordinates (latitude, longitude) are: 1: 44°05'21", 10°49'56"; 2: 44°05'21", 10°49'10"; 3: 44°05'20", 10°49'12"; 4: 44°05'13", 10°49'00"; 5: 44°05'18", 10°49'12"; 6: 44°05'19", 10°49'47"; 7: 44°05'20", 10°49'51", holotypus ass.; 8: 44°05'20", 10°49'12"; 9: 44°05'19", 10°49'49"; 10: 44°05'20", 10°49'12"; 11: 44°05'20", 10°49'12"; 12: 44°05'13", 10°49'01"; 13: 44°05'20", 10°49'12"; 14: 44°05'20", 10°49'12"; 15: 44°05'20", 10°49'12"; 16: 44°05'13", 10°49'00"; 17: 44°04'09", 10°49'57"; 18: 44°04'09", 10°49'46"; 19: 44°05'19", 10°49'57"; 20: 44°05'19", 10°49'50"; 21: 44°05'20", 10°49'12"; 22: 44°05'19", 10°49'44"; 23: 44°05'20", 10°49'12"; 24: 44°05'21", 10°49'10"; 25: 44°05'13", 10°49'01".

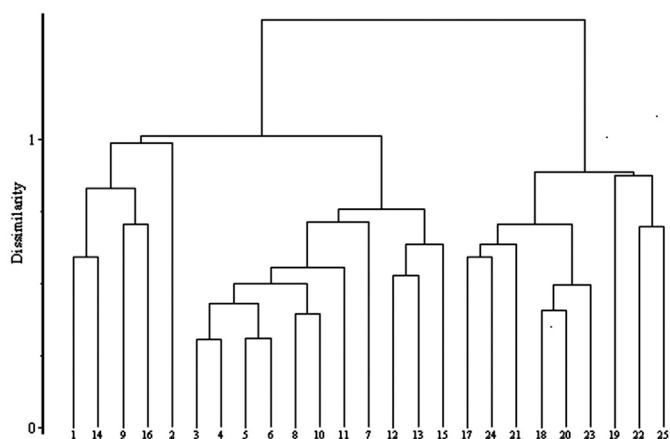


Figure 2.— Cluster (chord distance, complete link) of the linear scrubby formation with woodbine.

of humid megaforbs with good cover values indicating their proximity to streams and rocks.

In view of the unusualness of the coenoses and their ecological context, we propose the new association *Geranio nodosi-Loniceretum alpigenae* hoc loco (*holotypus*: rel. 9, Table 7). Furthermore, the floral composition highlights the presence of a typical subassociation *loniceretosum alpigenae hoc loco holotypus* rel. 9, Table 6, characterised by the presence of *Geranium nodosum*, *Dryopteris filix-mas* and *Stellaria nemorum*. Moreover, a subassociation with dominance of *Lonicera nigra* was observed for which the name *loniceretosum nigrae* hoc loco (*holotypus*: rel. 23, Table 7) is proposed. The subassociation *loniceretosum nigrae* differs from the typical one due to semi-heliophile species of rocky substratum and with flowing water such as *Adenostyles alpina* and *Athyrium filix-foemina*. The new association is typical of a beech wood mantle or riparian alder groves. Due to its physiognomic and structural character we propose to refer this new association to the class *Rhamno Prunetea*, order *Sambucetalia racemosi* (RIVAS-MARTÍNEZ & al., 2002). Although some communities reported for the central Apennines are dubiously referred to *Amelanchierion ovalis* Arlot 1985 (DE FOCAULT 1991; STANISCI, 1997) or more recently to *Berberidion sensu* Tüxen 1952 (CUTINI & al., 2002), these contain *Lonicera alpigena*, which makes their floral composition different from that of our coenoses, and the ecological conditions generally reported for this alliance are also quite different. In

our opinion, this vegetation type can satisfactorily include any alliance.

MEGAFORBS (TABLE 8)

Communities of tall herbs, dominated by graminoids or herbs and distributed along forest margins and in shrubby formations in contact with streams, have been treated as megaforbs. The communities formed by these species are never distributed over large areas, also recalling the particular geomorphology of the phytocoenoses. The syntaxonomic study of this type of vegetation is defined here due to a lack of data referenced to southern Europe. The syntaxonomy of these communities has only recently been determined by MICHL & al. (2010) in research focused on central Europe, including the Alps, where we have been working. The shortage of phytosociological data for areas in Italy underlines the need for further study of these vegetation types.

Cluster analysis splits our relevés into two main groups (Figure 3). The first is characterised by the presence of *Galio-Urticetea* species and is found below 800 m, while the second is distinguished by *Mulgedio-Aconitetea* species and is generally located at higher altitudes. The first group is dominated by *Petasites hybridus*, a semiheliophilous geophyte that finds its optimum conditions on small, steep surfaces and on mineral substrates covered with a thin layer of soil. Under these conditions it develops in luxuriant populations covering 100% of the surface, lea-

Table 8
Megaforbs

		Aggr. <i>Petasites hybridus</i> (Group A)																																					
		(Aegopodion podagrariae, Galio aparines-Alliariaetalia petiolatae, Galio-Urticetea)																																					
		Aggr. <i>Eupatorium cannabinum-Calamagrostis arundinacea</i> (Group B1)										Aggr. - <i>Adenostyles alpina-Petasites albus</i> (Group B2)																											
		Doronicum austriaci-Aruncetum vulgare in Korász & Medwecka-Korász 1967 subsp. geranietosum nodosi (Vágge 1996) comb. nov. (Group B3)										(Arunico dioici-Petasiton albi, Calamagrostietalia villosae, Mulgedio-Aconitetea)																											
		61	58	80	58	104	88	107	107	84	106	107	104	79	77	135	133	115	115	117	91	90	109	110	91	91	85	87	94	107	84	107	107						
Altitude (l=10m)		-	10	10	25	-	5	6	35	60	<5	40	25	60	60	15	10	60	5	10	<5	8	10	<5	5	<5	5	<5	35	60	60	15	10						
Slope (°)		-	SW	ESE	-	SE	S	NW	SSE	SW	SSW	SSW	SW	NW	E	NW	NW	S	SW	NEWSW	N	W	NW	SSW	W	NN	WN	NN	WN	NN	WN	WN							
Aspect		25	6	10	25	6	35	30	15	20	6	20	25	50	16	5	15	40	20	7	10	12	40	30	50	45	25	15	40	15	12	4	40	45					
Surface (m ²)		100	100	100	100	100	100	100	80	60	70	40	40	90	50	45	70	100	50	100	70	90	100	70	90	90	85	90	50	80	95	100							
Cover (%)		A	A	A	A	A	B1	B1	B1	B1	B1	B1	B1	B1	B1	B1	B1	B1	B2	B2	B2	B2	B2	B2	B2	B2	B2	B3	B3	B3	B3	B3	B3	B3	B3				
Cluster		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33					
N. relevé																																							
Characteristics of Aggr. <i>Petasites hybridus</i> and <i>Galio-Urticetea</i>																																							
<i>Petasites hybridus</i> subsp. <i>hybridus</i>		5	4	5	5	5																																	
<i>Clematis vitalba</i>		+	r	r	r	r																																	
Aggr. <i>Eupatorium cannabinum-Calamagrostis arundinacea</i>																																							
<i>Calamagrostis arundinacea</i>		2	1	2	2	4	3	2	2	4	3	3	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Eupatorium cannabinum</i> subsp. <i>cannabinum</i>		+	+	r	.	.	+	1	+	2	2	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Typical variant																																							
<i>Galium mollugo</i> subsp. <i>erectum</i>		.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Dactylis glomerata</i>		
<i>Angelica sylvestris</i> subsp. <i>sylvestris</i>		
<i>Lactuca muralis</i>		
<i>Equisetum arvense</i> subsp. <i>arvense</i>		.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Solanum dulcamara</i>		
Altitudinal variant																																							
<i>Valeriana tripteris</i> s.l.		
<i>Parnassia palustris</i> subsp. <i>palustris</i>		
<i>Saxifraga aizoides</i>		
Characteristics of <i>Doronicum-Aruncetum geranietosum nodosi</i>																																							
<i>Adenostyles alpina</i>	
<i>Geranium nodosum</i>	
<i>Veronica urticifolia</i>	

N. relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33						
Typical variant with <i>Aruncus dioicus</i>																																							
<i>Aruncus dioicus</i>		
<i>Prenanthes purpurea</i>	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lucula nivea</i>	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aggr. <i>Adenostyles alpina</i> - <i>Petasites albus</i>																																							
<i>Chaerophyllum hirsutum</i>	2	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Geranium robertianum</i>	
<i>Doronicum pardalianches</i>	
<i>Stachys sylvatica</i>	r	.	r	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Saxifraga rotundifolia</i> subsp. <i>rotundifolia</i>	
<i>Circaea x intermedia</i>	
<i>Cardamine bulbifera</i>	
Characteristics and differentials of <i>Mulgedio-Aconitetea</i>																																							
<i>Petasites albus</i>	4	4	4	3	1	1	2	1	2	1	3	2	5	3	4	4	3	4	5	4	3	3	2	4	3	5							
<i>Urtica dioica</i> subsp. <i>dioica</i>
<i>Dryopteris filix-mas</i>
<i>Stellaria nemorum</i> subsp. <i>montana</i>
<i>Athyrium filix-femina</i>	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Impatiens noli-tangere</i>
<i>Oxalis acetosella</i>
<i>Gentiana asclepiadea</i>
Other species																																							
<i>Agrostis capillaris</i>	+	+	+	
<i>Brachypodium sylvaticum</i> subsp. <i>sylvaticum</i>
<i>Campanula trachelium</i> subsp. <i>trachelium</i>	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cardamine asarifolia</i>
<i>Cardamine heptaphylla</i>	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Crepis paludosa</i>	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Euphorbia dulcis</i>
<i>Festuca heterophylla</i>
<i>Fragaria vesca</i> subsp. <i>vesca</i>
<i>Heracleum sphondylium</i> s.l.
<i>Hieracium murorum</i>
<i>Lonicera alpigena</i> subsp. <i>alpigena</i>

N. relevé	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33					
<i>Lonicera nigra</i>		
<i>Melica uniflora</i>	+	
<i>Myrrhis odorata</i>
<i>Rubus idaeus</i> subsp. <i>idaeus</i>
<i>Rumex scutatus</i> subsp. <i>scutatus</i>
<i>Sabia glutinosa</i>	+
<i>Sesleria argentea</i>
<i>Taraxacum officinale</i>
<i>Vicia cracca</i>

Other species: *Lathyrus sylvestris* subsp. *sylvestris* r in 4, + in 9 and 13; *Silene pusilla* subsp. *pusilla* + in 11, 12 and 16; *Hepatica nobilis* + in 16 and 29, r in 28; *Cardamine impatiens* subsp. *impatiens* + in 18 and r in 22 and 28; *Asplenium viride* + in 18 and 30, r in 23; *Cardamine hirsuta* r in 20, 22 and 24; *Myosotis sylvatica* subsp. *sylvatica* r in 21, 23 and 33; *Hypericum perforatum* + in 1, r in 4; *Arabis turrita* r in 4 and 8; *Seseli libanotis* subsp. *libanotis* r in 4 and 13; *Brachypodium rupestre* r in 4, + in 8; *Mentha aquatica* subsp. *aquatica* r in 2 and 5; *Milium effusum* + in 20 and 23; *Prunella vulgaris* subsp. *vulgaris* + in 8 and 13; *Dryopteris filix-mas* + in 8, r in 18; *Imperatoria ostruthium* r in 9 and 20; *Inula conyzae* r in 8 and in 29; *Juncus articulatus* + in 11 and 12; *Linum catharticum* + in 11 and 12; *Agrostis stolonifera* + in 8, 12 and 13; *Epilobium dodonei* + in 8, r in 13; *Epilobium anagallidifolium* r in 11, + in 12; *Leontodon hispidus* r in 12 and 17; *Brachypodium genuense* + in 13 and 17; *Dactylorhiza maculata* subsp. *fuchsii* r in 17 and 29; *Epilobium montanum* r in 18 and 24; *Sambucus nigra* r in 3 and 23; *Scrophularia nodosa* r in 22 and 23; *Hedera helix* r in 27 and 29; *Myosotis decumbens* subsp. *florentina* + in 18 and 20; *Phyteuma scorzonifolium* r in 18 and 27; *Festuca rubra* + in 16 and 17; *Ranunculus lanuginosus* r in 7 and 29; *Pimpinella saxifraga* r in 12 and 13; *Barbarea vulgaris* subsp. *vulgaris*, *Potentilla erecta* and *Verbena officinalis* r, *Arctium lappa*, *Dipsacus fullonum*, *Picris hieracioides* s.l. and *Salix eleagnos* + in 1, *Emerus major* r in 3; *Artemisia vulgaris*, *Scrophularia canina*, *Silene vulgaris* s.l. and *Tussilago farfara* r in 4; *Viola reichenbachiana* r, *Lotus corniculatus* and *Schedonorus pratensis* subsp. *apenninus* + in 8; *Aegopodium podagraria* + in 10; *Carex frigida* and *Epilobium viviflorum* +, *Veronica beccabunga* 1 in 11; *Hieracium tomentosum*, *Hypericum richeri* subsp. *richeri* and *Trifolium pratense* r, *Carex viridula* and *Cruciata glabra* + in 12; *Erysimum cheiri* r, *Cirsium bertolonii* and *Thymus pulegioides* + in 13; *Carex pendula* + in 14; *Senecio vulgaris*, *Saxifraga cuneifolia* subsp. *cuneifolia* and *Saxifraga paniculata* + in 17; *Asplenium trichomanes* s.l., *Polystichum setiferum*, *Sedum acre* and *Sedum album* r in 18; *Daphne mezereum* r in 20; *Circaea lutetiana* subsp. *lutetiana* and *Arum maculatum* + in 21; *Aquilegia atrata*, *Pulmonaria hirta* apennina and *Sanicula europea* r in 22; *Carex remota* and *Scrophularia auriculata*, subsp. *auriculata* r in 23; *Gymnocarpium dryopteris*, *Luzula pilosa* and *Polypodium interjectum* r, *Deschampsia cespitosa* subsp. *cespitosa* + in 24; *Vicia altissima* r in 26; *Cephalanthera longifolia* and *Geum urbanum* r in 27; *Polystichum lonchitis* and *Senecio ovatus* r in 29; *Moehringia muscosa* r in 30; *Lamium galeobdolon* + in 32.

Localities: All from the surroundings of the Verdiana river; geographical coordinates (latitude, longitude) are: 1: 44°04'04", 10°47'20"; 2: 44°04'10", 10°47'03"; 3: 44°04'10", 10°47'03"; 4: 44°04'45", 10°48'53"; 5: 44°04'10", 10°47'03"; 6: 44°05'34", 10°49'12"; 7: 44°05'08", 10°49'01"; 8: 44°05'20", 10°49'12"; 9: 44°05'42", 10°49'16"; 10: 44°05'42", 10°49'16"; 11: 44°05'39", 10°49'15"; 12: 44°05'42", 10°49'16"; 13: 44°05'51", 10°49'26"; 14: 44°04'36", 10°48'45"; 15: 44°04'32", 10°48'42"; 16: 44°06'23", 10°49'47"; 17: 44°06'23", 10°49'47"; 18: 44°05'54", 10°49'32"; 19: 44°05'54", 10°49'32"; 20: 44°05'57", 10°49'34"; 21: 44°05'17", 10°49'03"; 22: 44°05'17", 10°49'03"; 23: 44°05'48", 10°49'18"; 24: 44°05'49", 10°49'20"; 25: 44°05'17", 10°49'03"; 26: 44°05'17", 10°49'03"; 27: 44°04'56", 10°48'58"; 28: 44°05'05", 10°48'59"; 29: 44°05'25", 10°49'08"; 30: 44°05'42", 10°49'16"; 31: 44°04'55", 10°48'59"; 32: 44°05'42", 10°49'16"; 33: 44°05'42", 10°49'16".

ving very little space for other species to establish. Such coenoses appear similar to those reported along the Lima-Serchio system by ARRIGONI & PAPINI (2003) ascribed to the association *Phalarido-Petasitetum hybridi* Schwick. 1933 (Table 8, group A), frequent in the middle course of many Apennine watercourses (HRUSKA, 1988). PEDROTTI (1995) highlights some of the problems in the interpretation of *Petasites hybridus* vegetation. Indeed, some authors such as OBERDORFER (1983) give the association *Phalarido-Petasitetum* a wide ecological circumscription and recognise different associations within it. Other authors separate the coenoses of mountain plains and refer them to another association: *Chaerophyllo-Petasitetum officinalis* Kaiser 1926.

The absence of stenoecious species in our sampling and comparison with the data in the literature do not allow us to refer to associations or other syntaxa already present, nor do they permit us to describe new syntaxons. For this reason, we prefer to refer these communities to a *Petasites hybridus* basal phytocoenon (sensu POLDINI & SBURLINO, 2005).

Communities recorded above 800 m are dominated by *Petasites albus*, which forms dense mats also in the herbaceous layer of *Fagus* and *Ostrya* forests (Table 2 and 4 respectively). The cluster (Figure 3) shows three different situations: Table 8, groups B1, B2 and B3.

Group B1 clusters the relevés characterised by *Calamaogrostis arundinacea* which forms nume-

rous populations on very steep, stony surfaces, well exposed to light and often located in small ravines among the rocks near the river. *Calamaogrostis arundinacea* is considered characteristic of the association *Digitalo ambiguae-Calamaogrostietum arundinaceae* Sillinger 1933 (MICHL. & al., 2010) and is ascribed to the alliance *Calamaogrostion arundinaceae* (Luquet 1926) Oberd. 1957. However we cannot refer to this association due to the absence of the other characteristic species. The presence of *Eupatorium cannabinum* distinguishes our coenoses so we recognise a particular grouping. The surveys of the B1 group reveal two situations. Set 6-13 is characterised by forest margin species such as *Galium mollugo* subsp. *erectum*, *Dactylis glomerata* and *Solanum dulcamara*. These are more or less influenced by human activity and are found on substrates rich in mineral nutrients. On the other hand, set 16-18 differs in the presence of acidophilous and oligotrophic species located on higher-altitude sites (*Parnassia palustris*, *Saxifraga aizoides*, *Valeriana tripteris*). All the phytocoenoses of the B1 group are characterised by *Petasites albus* and *Adenostyles alpina* which fall into two different syntaxa belonging to the order *Calamaogrostietalia villosae* Pawl. & al. 1928: *Calamaogrostion arundinaceae* and *Arunco-Petasition albi* Br.-Bl. & Sutter 1977. On this basis our relevés evidence a state of transition between these two alliances.

Groups B2 and B3 can be referred to the association *Doronico austriaci-Aruncetum vulgaris* (=

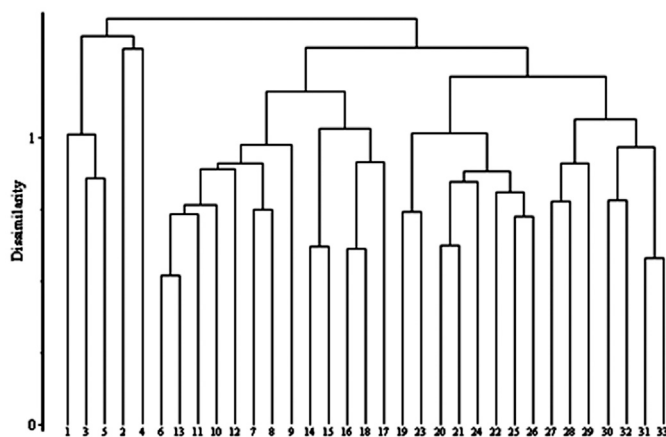


Figure 3.– Cluster (chord distance, complete link) of the megaforbs.

Arunco dioici-Petasitetum albi Br.-Bl. & Sutter 1977) already reported for the Lima-Serchio system by ARRIGONI & PAPINI (2003, sub: *Arunco-Petasitetum albi*), and particularly to the subassociation *geranietosum nodosi* Vagge 1996 described in the Ligurian Apennines as beech wood margins with *Geranium nodosum* (*Geranio nodosi-Fagion sylvaticae* Gentile 1975). Such a subassociation is also reported in the Piedmont Apennines by CASTELLI & al. (2001). Group B3, in particular, represents the typical variant with *Arunco dioicus*, while group B2 clusters the relevés that are depleted in characteristic species of association and enriched by species such as *Saxifraga rotundifolia*, typical of cool, partially-shaded sites which are rich in mineral nutrients such as *Urtica dioica*, *Circaea intermedia* and *Geranium robertianum* characterised by a gentle slope and less affected by flooding. These relevés can be recognised as a particular group defined by *Adenostyles alpina* and *Petasites albus*.

BRACHYPODIUM GENUENSE GRASSLANDS (TABLE 9)

The non-forested steeper slopes above 1500 m are characterised by small patches of grassland dominated by *Brachypodium genuense*. This vegetation type grows in rocky areas, and thus many lithophilous species such as *Seseli libanotis* and *Alchemilla saxatilis* can be found. These two species with *Galium lucidum* and *Cerastium arvense* subsp. *suffruticosum* can be used to characterise a typical grouping of these habitats. We observed that in the most eroded areas glareicolous species are widespread; these may indicate a variant towards conditions typical of the associations of *Thlaspietea rotundifolii* class without forming coenoses referable to this class. Similar coenoses located in the Aemilian Apennines have been defined as *Brachypodium genuense* and *Seseli libanotis* and temporarily ascribed to the alliance *Bromion erecti* by TOMASELLI & al. (1996). The *Brachypodium genuense* grasslands in the Tuscan-Aemilian Apennines are currently being studied, but from the initial analysis they show numerous affinities with the *Nardetea strictae* class (FOGGI & al., 2010). Additionally, both mountainous *Brachypodium* grasslands of the high Garfag-

nana Valley, referred to a *Brachypodium genuense* and *Anthoxanthum odoratum* grouping by GABELLINI & al. (2006), and the Pratomagno grasslands dominated by *Brachypodium* (VICIANI & GABELLINI, 2000), are both attributed to the *Nardetea* class. Furthermore, the communities of the Modena Apennines (TOMASELLI & al., 1996) and those growing in the Upper Sestaione Valley (FOGGI & al., 2007) have also been referred to the same class. Nevertheless, the *Brachypodium genuense* grasslands of the Central Apennines are also included in *Nardetea strictae* (DI PIETRO & al., 2005).

This treatment should therefore be considered provisional and pending a more thorough syntaxonomic study of these grasslands considering the dynamic role of these communities.

VEGETATION OF WET ROCKY FACES (TABLE 10)

As already mentioned, the river banks are often almost vertical. There are many north-facing, shady and humid sites mainly along the Fosso Selvori. The phytocoenoses of this vegetation type, dominated by ferns, can be ascribed to the *Cystopteridetum fragilis* association (FOGGI & al., 2007, 2008). A peculiar aspect was observed inside the association, which differs due to the presence of *Saxifraga cuneifolia* subsp. *cuneifolia*, and develops on intraforestal rocks with some surface water flow and a higher-than-average topographic position for the association, which is more usually abundant at the base of rocks and in moister, shadier sites. This aspect of the community we interpret as subassociation *saxifragetosum cuneifoliae* subass. nova hoc loco (*holotypus*: rel. 3, Table 8).

In both cases, besides the species characteristic of stony site syntaxa, there is a group of species more typical of megaforb communities such as *Veronica urticifolia*, *Adenostyles alpina*, *Chaerophyllum hirsutum* and *Calamagrostis arundinacea*.

ALPINE STREAM VEGETATION (TABLES 11 AND 12)

We can distinguish two kinds of sites along small streams; the rocks in the middle and the

Table 9
Brachypodium genuense grasslands
 Aggr. *Brachypodium genuense* - *Seseli libanotis*
 (*Nardetalia strictae*, *Nardetea strictae*)

Altitude (1=10m)	154	154	153	166	160	153	154	155	156	156	154	156	161
Slope (°)	60	60	40	60	40	35	30	45	40	35	5	40	40
Aspect	SE	E	NE	NE	E	ESE	SW	E	E	SE	S	SSE	NE
Surface (m ²)	10	10	10	10	10	10	10	10	10	10	10	10	10
Cover (%)	70	45	70	50	60	60	60	100	80	40	60	100	100
N. relevé	1	2	3	4	5	6	7	8	9	10	11	12	13
Aggr. <i>Seseli libanotis</i> - <i>Brachypodium genuense</i>													
<i>Seseli libanotis</i> subsp. <i>libanotis</i>	1	1	1	1	2	1	3	+	1	r	1	3	r
<i>Galium lucidum</i> subsp. <i>lucidum</i>	r	+	+	+	+	+	+	+	.	+	.	.	.
<i>Cerastium arvense</i> subsp. <i>suffruticosum</i>	.	.	+	r	.	.	+	+	+	+	.	.	+
Variant on screes with <i>Cirsium bertolonii</i>													
<i>Cirsium bertolonii</i>	.	.	.	.	r	2	1	3	2	1	1	2	2
<i>Rumex scutatus</i> subsp. <i>scutatus</i>	.	.	.	+	.	r	1	r	r	r	+	+	+
Characteristic species of higher syntaxa													
<i>Brachypodium genuense</i>	4	3	4	3	3	4	3	3	1	3	4	4	4
<i>Rhinanthus minor</i>	r	r	1	+	+	+	+	1	r	r	+	+	+
<i>Festuca rubra</i>	.	.	1	.	.	+	+	+	+	+	1	.	1
<i>Alchemilla saxatilis</i>	2	+	2	1	.	.	1	4	4	.	.	.	.
<i>Campanula scheuchzeri</i> subsp. <i>scheuchzeri</i>	.	.	r	r	.	.	.	.	.	.	.	.	r
<i>Dianthus deltooides</i> subsp. <i>deltooides</i>	.	.	.	.	+	.	.	.	.	.	.	+	r
<i>Carex frigida</i>	.	.	.	.	r	.	.	.	r	.	.	.	.
Species of the neutro-basophilous grasslands													
<i>Acinos alpinus</i>	.	.	.	1	r	2	+	+	+	.	.	+	.
<i>Asperula aristata</i> subsp. <i>oreophila</i>	.	+	.	1	+	+	.	.	.	.	+	.	.
<i>Saxifraga paniculata</i>	+	+	.	r	.	.	.	.	.	.	.	.	.
<i>Avenula praetutiana</i>	.	.	.	.	.	.	.	.	r	.	r	.	.
<i>Minuartia verna</i> subsp. <i>verna</i>	.	.	.	+	.	.	.	.	+	.	.	.	.
<i>Sedum album</i>	.	.	.	.	+	+	.	.	.	.	.	.	.
<i>Silene saxifraga</i>	+	.	.	+	.	.	.	.	.	.	.	.	.
Other species													
<i>Thymus pulegioides</i>	+	2	+	1	1	.	+	.	1	.	.	.	.
<i>Lotus corniculatus</i> subsp. <i>alpinus</i>	+	.	.	+	.	.	.	+	.	.	.	+	+
<i>Hieracium villosum</i>	.	+	r	+	r	.	.	.	.	.	.	+	.
<i>Carduus carlinifolius</i> subsp. <i>carlinifolius</i>	.	.	.	.	+	.	+	.	.	+	.	.	+
<i>Arenaria bertolonii</i>	.	.	.	+	+	1	.	.	.	.	.	.	.
<i>Anthoxanthum odoratum</i> subsp. <i>odoratum</i>	.	.	.	.	+	.	.	.	.	.	+	.	+
<i>Leucanthemum coronopifolium</i> subsp. <i>ceratophylloides</i>	.	.	.	r	.	r	.	.	.	.	.	.	.
<i>Juncus alpinoarticulatus</i>	.	.	.	.	.	.	.	.	r	.	.	.	r
<i>Cerastium holosteoides</i>	.	.	.	.	+	.	+	.	.	.	.	.	.
<i>Robertia taraxacoides</i>	.	r	.	r	.	.	.	.	.	.	.	.	.
<i>Trifolium repens</i>	+	.	.	.	.	.	.	.	1	.	.	.	.

Other species: *Draba aizoides* and *Erigeron alpinus* subsp. *alpinus* r, *Viola calcarata* subsp. *cavillieri* + in 4; *Orchis mascula* subsp. *mascula* r in 5, *Leucanthemum heterophyllum* r, *Trifolium pratense* + in 6; *Cystopteris fragilis* and *Euphrasia minima* r in 8; *Alchemilla glabra* r in 9; *Hypericum richeri* subsp. *richeri* r, *Phleum alpinum* + in 11; *Achillea tomentosa* r, *Anthyllis vulneraria* s.l. and *Dactylorhiza maculata* subsp. *fuchsii* + in 12; *Dryopteris filix-mas* r, *Geranium phaeum* and *Allium schoenoprasum* + in 13.

Localities: All from the surroundings of the Verdiana river; geographical coordinates (latitude, longitude) are: 1: 44°06'37", 10°49'40"; 2: 44°06'37", 10°49'40"; 3: 44°06'37", 10°49'40"; 4: 44°06'42", 10°49'34"; 5: 44°06'42", 10°49'34"; 6: 44°06'42", 10°49'34"; 7: 44°06'37", 10°49'40"; 8: 44°06'38", 10°49'41"; 9: 44°06'39", 10°49'40"; 10: 44°06'39", 10°49'40"; 11: 44°06'38", 10°49'41"; 12: 44°06'39", 10°49'40"; 13: 44°06'41", 10°49'37".

Table 10
 Rocky wet habitat
Asplenio viridi-Cystopteridetum fragilis Oberdorfer (1936) 1949
Asplenio viridis-Cystopteridetum fragilis Oberdorfer (1936) 1949 subass.
saxifragetosum cuneifoliae subass. nova hoc loco
 (*Cystopteridion*, *Potentilletalia caulescentis*, *Asplenieta trichomanis*)

Altitude (1=10m)	109	110	115	105	98	103	98	115	94	102	104	110	111	114	110	105	96	1050
Slope (°)	90	90	90	90	90	50	90	90	90	90	90	90	90	50	90	90	90	90
Aspect	NW	N	NW	NW	NNW	NW	NW	NE	NNE	NW	NW	NNE	NNE	N	NNE	NNW	NW	NNW
Surface (m ²)	2	1	2	1	1	2	2	2	1	2	1	1	1	2	1	1	1	1
Cover (%)	40	50	30	40	70	40	50	30	80	30	50	65	40	30	60	50	50	40
Cover of musci (%)	<5	35	<5	15	35	-	15	-	65	35	<5	15	<5	-	15	15	15	-
N. relevé	1	2	3*	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Characteristics of association																		
<i>Cystopteris fragilis</i>	+	r	r	.	.	+	.	.	.	.	3	1	1	2	1	2	1	2
<i>Asplenium viride</i>	+	.	+	.	.	.	r	+	.	.	.	+	r	.	1	.	1	.
Differentials of subassociation																		
<i>Saxifraga cuneifolia</i> subsp. <i>cuneifolia</i>	2	2	2	1	1	2	3	2	3	1	1	+	.	.	.	.	.	.
Characteristics of higher syntaxa																		
<i>Asplenium trichomanes</i> s.l.	+	r	+	r	+	+	.	.	+	+	.	1	.	+	1	.	+	.
<i>Valeriana tripteris</i> s.l.	+	r	.	.	.	.	.	+	1	.	.	+	.	.	.	2	.	2
<i>Saxifraga paniculata</i>	2	r	1	2	2	.	.	.	.	.	.	.	2	.	.	.	.	.
Species of wet edge																		
<i>Veronica urticifolia</i>	r	1	+	r	.	+	+	1	.	+	.	r	r	.	r	.	.	.
<i>Adenostyles alpina</i>	.	.	+	.	.	.	r	r	.	.	.	2	.	.	2	.	+	+
<i>Chaerophyllum hirsutum</i>	+	.	.	.	.	.	+	.	.	r	.	.	+	.	.	.	.	.
<i>Calamagrostis arundinacea</i>	+	.	.	1	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Other species																		
<i>Geranium nodosum</i>	.	r	.	.	.	+	+	.	.	+	.	.	+	1	.	.	.	.
<i>Sesleria argentea</i>	.	.	.	.	.	1	.	+	.	.	1	+	.	1	.	1	.	.
<i>Dryopteris filix-mas</i>	.	.	r	.	.	.	.	.	.	.	.	.	r	r	.	.	r	.
<i>Saxifraga rotundifolia</i> subsp. <i>rotundifolia</i>	.	.	.	.	.	+	.	.	.	.	.	.	r	+	.	.	1	.
<i>Geranium robertianum</i>	.	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.
<i>Hieracium sylvaticum</i>	+	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	+
<i>Lactuca muralis</i>	+	.	.	.	.	.	.	r	.	.	.	.	.	+	.	.	.	.
<i>Oxalis acetosella</i>	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
<i>Parnassia palustris</i> subsp. <i>palustris</i>	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Prenanthes purpurea</i>	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.

Other species: *Senecio ovatus* + in 2; *Saxifraga aizoides* r, *Cardamine asarifolia* + in 3; *Alchemilla cf. saxatilis* r in 4; *Anogramma leptophylla* r in 5; *Angelica sylvestris* subsp. *sylvestris* r, *Hepatica nobilis* + in 7; *Emerus major* + in 10; *Polypodium vulgare* r, *Athyrium filix-femina*, *Cardamine hirsuta*, *Circaea alpina* subsp. *alpina* and *Cruciata glabra* + in 14; *Petasites albus* + in 16.

Localities: All from the surroundings of the Verdiana river; geographical coordinates (latitude, longitude) are: 1: 44°05'48", 10°49'17"; 2: 44°05'49", 10°49'20"; 3: 44°05'55", 10°49'32"; 4: 44°05'37", 10°49'14"; 5: 44°05'26", 10°49'19"; 6: 44°05'33", 10°49'11"; 7: 44°05'26", 10°49'19"; 8: 44°05'54", 10°49'32"; 9: 44°05'24", 10°49'09"; 10: 44°05'30", 10°49'17"; 11: 44°05'34", 10°49'11"; 12: 44°06'37", 10°49'40"; 13: 44°05'50", 10°49'21"; 14: 44°05'35", 10°49'13"; 15: 44°05'37", 10°49'14"; 16: 44°05'37", 10°49'14"; 17: 44°05'24", 10°49'12"; 18: 44°05'37", 10°49'14".

banks. On a mossy carpet, generally dominated by *Brachytecium rivulare*, and on the stones in contact with flowing water, coenoses are characterised by *Carex frigida* and *Silene pusilla*. These communities can also be found near the sources, together with *Pinguicula vulgaris*, *Saxifraga aizoides* and *Epilobium anagallidifolium* (Table 10). This vegetation type is widespread in the Tuscan-Aemilian Apennines, and its phytosociological situation is currently under study (CONSTANZO & al., 2009). Al-

most monospecific populations of *Cardamine asarifolia* grow on the stream banks in close contact with the above-mentioned coenoses (Table 11). These coenoses are strictly related to well-oxygenated, fast-flowing water (TOMASELLI & al., 1996). We refer these coenoses to the *Chaerophyllo-Cardaminetum asarifoliae* association described by GERDOL & TOMASELLI (1988) for the Apuane Alps and reported by TOMASELLI & al. (1996) and FOGGI & al. (2007, 2008) in the Tuscan--Aemilian Apen-

Table 11
Alpine little river
Aggr. with *Silene pusilla* and *Carex frigida*
(*Cardamino-Montion*, *Montio-Cardaminetalia*, *Montio-Cardaminetea*)

	1530	1540	1560	1580	1540	1650	1600	1640	1650	1640	1640
Altitude (m)	1530	1540	1560	1580	1540	1650	1600	1640	1650	1640	1640
Slope (°)	5	30	50	40	35	30	50	50	5	50	5
Aspect	SSE	SE	S	E	W	S	SE	S	S	SE	SE
Surface (m ²)	3	1	1	1	1.5	1	1	1	0.5	1	0.3
Cover (%)	60	100	100	100	80	100	100	100	100	85	100
Cover of musci (%)		<5				35	<5	15	65	65	35
N relevé	1	2	3	4	5	6	7	8	9	10	11
Characteristics of aggr.											
<i>Carex frigida</i>	3	4	2	1	+	1	1	2	1	1	2
<i>Silene pusilla</i> subsp. <i>pusilla</i>	1	+	2	4	2	.	1	1	+	r	3
Characteristic and differential species of higher syntaxa											
<i>Saxifraga aizoides</i>	+	1	4	1	4	2	3	4	2	3	3
<i>Chaerophyllum hirsutum</i>	1	.	.	.	.	.	.	+	.	.	+
<i>Cardamine asarifolia</i>	.	.	.	.	+	.	.	.	.	.	.
Differentials of <i>Caricetea nigrae</i>											
<i>Crepis paludosa</i>	1	2	1	2	.	3	4	1	+	+	2
<i>Pinguicula vulgaris</i>	+	+	.	r	r	+	.	.	+	+	.
<i>Parnassia palustris</i> subsp. <i>palustris</i>	.	.	r	.	1	.	.	.	+	+	.
<i>Epilobium anagallidifolium</i>	.	.	+	.	+	.	.	.	.	r	.
<i>Juncus alpinoarticulatus</i>	.	.	.	.	.	r	.	.	r	.	.
Other species											
<i>Alchemilla glabra</i>	.	.	.	.	+	.	.	+	.	r	r
<i>Deschampsia cespitosa</i> subsp. <i>cespitosa</i>	+	.	.	2	+	.	.	.	.	.	.
<i>Euphrasia minima</i>	.	.	.	.	+	r	.	.	.	.	.
<i>Festuca trichophylla</i> subsp. <i>trichophylla</i>	.	.	+	.	.	.	+	.	.	2	.
<i>Minuartia verna</i> subsp. <i>verna</i>	.	.	.	.	.	1	.	.	.	.	.
<i>Tussilago farfara</i>	+	+	1	.	3	.	.	.	.	.	.

Other species: *Myosotis sylvatica* subsp. *sylvatica* + in 1; *Rhinanthus minor* r, *Adenostyles alpina* + in 2; *Brachypodium genuense* and *Pedicularis tuberosa* r in 4; *Phyteuma orbiculare* r in 6; *Alchemilla saxatilis* r in 9; *Campanula scheuchzeri* subsp. *scheuchzeri* and *Hypericum richeri* subsp. *richeri* r, *Lotus corniculatus* subsp. *alpinus* + in 10. Localities: All from the surroundings of the Verdiana river; geographical coordinates (latitude, longitude) are: 1: 44°06'37", 10°49'41"; 2: 44°06'38", 10°49'41"; 3: 44°06'39", 10°49'42"; 4: 44°06'39", 10°49'38"; 5: 44°06'38", 10°49'41"; 6: 44°06'44", 10°49'39"; 7: 44°06'40", 10°49'37"; 8: 44°06'44", 10°49'39"; 9: 44°06'44", 10°49'39"; 10: 44°06'44", 10°49'39"; 11: 44°06'44", 10°49'39".

Table 12

Alpine little river with *Asarum* leaved bittercress
Chaerophyllo-Cardaminetum asarifoliae
 Gerdol & Tomaselli 1988

(*Cratoneurion commutatae*, *Montio-Cardaminetalia*,
Montio-Cardaminetea)

Altitude (m)	1540	1140	1140
Slope (°)	30	<5	5
Aspect	SW	NNW	SSW
Surface (m ²)	4	3	1.5
Cover (%)	90	70	90
N. relevé	1	2	3
Characteristics of assoc.			
<i>Cardamine asarifolia</i>	3	4	5
<i>Chaerophyllum hirsutum</i>	.	2	.
Differentials of <i>Caricetea nigrae</i>			
<i>Crepis paludosa</i>	1	.	.
<i>Carex frigida</i>	1	.	.
Other species			
<i>Adenostyles alpina</i>	2	.	.
<i>Tussilago farfara</i>	1	.	.
<i>Stellaria nemorum</i> subsp. <i>montana</i>	.	+	.
<i>Urtica dioica</i> subsp. <i>dioica</i>	.	.	r

Localities: All from the surroundings of the Verdiana river; geographical coordinates (latitude, longitude) are: 1: 44°06'38", 10°49'41"; 2: 44°05'52", 10°49'26"; 3: 44°05'52", 10°49'26".

nines. Both these vegetation types are ascribed to the *Montio Cardaminetea* class.

CONCLUSIONS

This phytosociological research has detected 18 types of vegetation in the Verdiana River Valley referable to different rank syntaxa. A new associa-

tion is described for the forest canopy vegetation characterised by *Lonicera nigra* and *Lonicera alpigena*, species which are rare in the Apennines but well represented in the area under study.

The *Doronico austriaci-Aruncetum vulgaris* association has been confirmed for the megaforb communities. Other vegetation types investigated are considered to be distinct plant communities but due to scant information in the literature, we prefer not to assign them syntaxonomical status and they are instead interpreted as groupings.

A new subassociation on rock faces is described for the association *Cystopteridetum fragilis*, dominated by *Saxifraga cuneifolia*. It represents coenoses of rocks and boulders located in the understory of the beech woods of the northern Apennines.

These surveys enable the identification of habitats of considerable interest for conservation, and these are listed in Annex I of Habitats Directive 92/43/EEC (reported in Table 12) as defined in the Interpretation Manual of European Union Habitats (EC, 2007) and in Manuale italiano di interpretazione (BIONDI & BLASI, 2009). Two of these habitats (indicated with asterisc*) are of priority value.

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SYNTAXONOMIC SCHEME

MONTIO-CARDAMINETEA Br.-Bl. & Tüxen ex Br.-Bl. 1948*Montio-Cardaminetalia* Pawłowski in Pawłowski, Sokołowski & Wallisch 1928*Cardamino-Montion* Br.-Bl. 1926Aggr. *Silene pusilla* e *Carex frigida**Cratoneurion commutatae* Koch 1928*Chaerophyllo-Cardaminetum asarifoliae* Gerdol & Tomaselli 1988*ASPLENIETEA TRICHOMANIS* (Br.-Bl. in Meier & Br.-Bl. 1934) Oberdorfer 1977*Potentilletalia caulescentis* Br.-Bl. in Br.-Bl. & Jenny 1926*Cystopteridion* (Nordhagen 1936) J.L. Rich. 1972*Cystopteridetum fragilis* Oberdorfer 1938subass. *saxifragetosum cuneifoliae* subass. nova*GALIO-URTICETEA* Passarge ex Kopecký 1969*Galio aparines-Alliarietalia petiolatae* Görs & Müller 1969*Aegopodion podagrariae* Tüxen 1967Aggr. *Petasites hybridus**MULGEDIO-ACONITETEA* Hadač & Klika in Klika & Hadač 1944*Calamagrostietalia villosae* Pawłowski in Pawłowski, Sokołowski & Wallisch 1928*Arunco dioici-Petasition albi* Br.-Bl. & Sutter 1977*Doronic austriaci-Aruncetum vulgaris* Kornaś in Kornaś & Medwecka-Kornaś 1967subass. *geranietosum nodosi* (Vagge 1996) comb. nov.Aggr. *Adenostyles alpina* e *Petasites albus*Aggr. *Eupatorium cannabinum* e *Calamaogrostis arundinacea**NARDETEA STRICTAE* Rivas Goday in Rivas Goday and Rivas Martinez 1963*Nardetalia strictae* Oberdorfer ex Preising 1949Aggr. *Brachypodium genuense* e *Seseli libanotis**RHAMNO-PRUNETEA* Rivas Goday & Borja ex Tüxen 1962*Sambucetalia racemosae* Oberdorfer ex Passarge in Scamoni 1963*Geranio nodosi-Loniceretum alpigenae* ass. novasubass. *loniceretosum alpigenae* subass. novasubass. *loniceretosum nigrae* subass. nova*SALICI PURPUREAE-POPULETEA NIGRAE* (Rivas-Martínez & Cantó ex Rivas-Martínez, Bascónes, T.E. Díaz, Fernández González & Loidi 1991) Rivas-Martínez & Cantó 2002*Salicetalia purpureae* Moor 1958*Salicion incanae* Aichinger 1933*Salicetum incano-purpureae* Sillinger 1933subass. *petasitetosum hybridi* Oriolo & Poldini 2002*Populetalia albae* Br.-Bl. 1931 ex Tchou 1948*Alnion incanae* Pawłowski in Pawłowski, Sokołowski & Wallisch 1928*Alnetum incanae* Lüdi 1921

QUERCO-FAGEEEA Br.-Bl. & Vlieger 1937*Fagetalia sylvaticae* Pawłowski in Pawłowski, Sokołowski & Wallisch 1928*Fagion sylvaticae* (Luquet 1926) Tüxen & Diemont 1936*Cardamino heptaphylla-Fagetum sylvaticae* Oberd. & Hoffman 1967*Carpinion betuli* Issler 1931 em. Oberd. 1957*Geranio nodosi-Carpinetum betuli* Pedrotti, Ballelli & Biondi 1982*Quercetalia pubescenti-petraeae* Klika 1933*Crataego laevigatae-Quercion cerridis* Arrigoni 1997*Roso caninae-Ostryetum carpinifoliae* (Barbero & Bono 1971) Ubaldi 1995

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