land

MDPI

Article

Alnus glutinosa Riparian Woodlands of Italy and Corsica: Phytosociological Classification and Floristic Diversity

Saverio Sciandrello [1,*], Claudia Angiolini [2], Gianluigi Bacchetta [3], Maurizio Cutini [4], Jeremy Dumoulin [5], Mauro Fois [3], Antonio Gabellini [2], Matilde Gennai [6], Lorenzo Gianguzzi [7], Marco Landi [2], Pietro Minissale [1], Christophe Panaïotis [5], Marta Puglisi [1], Giovanni Spampinato [8], Gianmarco Tavilla [1], Valeria Tomaselli [9], Daniele Viciani [6] and Gianpietro Giusso del Galdo [1]

[1] Department of Biological, Geological and Environmental Sciences, University of Catania, Via A. Longo 19, 95125 Catania, Italy
[2] Department of Life Sciences, University of Siena, Via PA Mattioli 4, 53100 Siena, Italy
[3] Centre for Conservation of Biodiversity (CCB), Department of Life and Environmental Sciences (DISVA), University of Cagliari, Viale Sant'Ignazio da Laconi 11-13, 09123 Cagliari, Italy
[4] Department of Science, University of Roma Tre, Viale Guglielmo Marconi, 446, 00146 Rome, Italy
[5] Conservatoire Botanique National de Corse, Office de l'Environnement de la Corse, 14 Av. Jean Nicoli, 20250 Corte, France
[6] Department of Biology, University of Florence, Via La Pira 4, 50121 Firenze, Italy
[7] Department of Agricultural, Food and Forest Sciences, University of Palermo, 90128 Palermo, Italy
[8] Department of AGRARIA, "Mediterranea" University of Reggio Calabria, Località Feo di Vito, 89122 Reggio Calabria, Italy
[9] Department of Biosciences, Biotechnologies and Environment, University of Bari "Aldo Moro", Via Orabona 4, 70125 Bari, Italy
* Correspondence: s.sciandrello@unict.it

Abstract: A comparative analysis of the riparian vegetation dominated by *Alnus glutinosa* in Italy and Tyrrhenian islands, based on literature data and unpublished relevés, is presented. A total of 456 phytosociological relevés were processed. For the definition of plant communities and alliances, hierarchical clustering was performed by using Bray-Curtis coefficient and Detrended Correspondence Analysis ordination methods. Identification of diagnostic species of the vegetation units was performed by means of the phi fidelity index. Quantum GIS software version 3.6 was used for the interpolation of the bioclimatic variables and *A. glutinosa* communities. Overall, a total of 18 *A. glutinosa*-riparian wood communities were distinguished for Italy and Tyrrhenian islands, of which two new associations and one new subassassociation are described. The classification of the relevés showed two main vegetation groups: the first one including the plant communities of the *Osmundo-Alnion* alliance, and the other including the vegetation of the *Ligustro vulgaris-Alnion glutinosae* alliance. This latest includes the riparian meso-thermophilous communities of central and northern Italy. Within the *Osmundo-Alnion* alliance, two subgroups can be recognized: the first one includes the thermophilous communities of the *Hyperico hircini-Alnenion glutinosae* sub-alliance, mainly spread in the Tyrrhenian islands, while the second group includes the mesophilous communities attributed to the new suballiance *Struthioptero-Alnenion glutinosae*, widespread in central Italy and the Corsican mountains. The present paper provides the first comprehensive and exhaustive scheme of the *A. glutinosa* riparian woodlands diversity in Italy and Corsica.

Keywords: alder; hygrophilous communities; phytosociology; riparian vegetation; syntaxonomy

Citation: Sciandrello, S.; Angiolini, C.; Bacchetta, G.; Cutini, M.; Dumoulin, J.; Fois, M.; Gabellini, A.; Gennai, M.; Gianguzzi, L.; Landi, M.; et al. *Alnus glutinosa* Riparian Woodlands of Italy and Corsica: Phytosociological Classification and Floristic Diversity. *Land* **2023**, *12*, 88. https://doi.org/10.3390/land12010088

Academic Editor: Shiliang Liu

Received: 15 November 2022
Revised: 17 December 2022
Accepted: 24 December 2022
Published: 28 December 2022

1. Introduction

Riparian woods and forests represent transitional habitats strongly dependent on hydrology and fluvial processes. These riparian ecosystems constitute a very important resource in the context of ecosystem services, such as protection from erosion, flow regulation, ecological corridors and effective control for non-point source pollution [1–3]. In

a perspective of environmental sustainability, it is necessary to guarantee their presence, permanence, quality and restoration. The ecological importance of riparian habitats regarding their structure, functionality and biodiversity conservation has been recognised in the Habitat Directive of the European Union [4]. In particular, *Alnus glutinosa* communities are recognized as priority habitat Code 91E0* "Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)". Unfortunately, in the Mediterranean Basin all riparian habitats are under severe human pressures, such as modification of the riparian areas determined by the artificialization and cleaning of the riverbeds, water catchment for irrigation and industrial uses, construction of dams or other barriers with consequent submersion upstream and flow reduction downstream and, last but not least, by agro-pastoral activities [5,6], which often cause the alteration of the structure and floristic composition of these plant communities and a consequent loss of ecosystem services [7]. As regards Italy, the fourth national reporting of the Habitats Directive (2013–2018; www.reportingdirettivahabitat.it (accessed on 12 October 2022)) stated high vulnerability for riparian forest habitats such as 92A0 (*Salix alba* and *Populus alba* galleries) and the above-mentioned 91E0*, with a poor state of conservation worsening compared to the previous reporting (2007–2012), in both the Mediterranean and continental bioregions.

In order to support the sustainable management of riparian habitats, their vegetation must first be carefully delineated in terms of structural features and floristic composition [8]. From the viewpoint of vegetation science, European temperate floodplain forests and zonal deciduous forests have been traditionally included either in the *Querco-Fagetea* class [9,10] or the *Carpino-Fagetea* class [11]. Recently, a last arrangement has been proposed by Mucina et al. [12], including the riparian forests of the Eurosiberian and Mediterranean regions in the class *Alno glutinosae-Populetea albae* P. Fukarek et Fabijanić 1968, and separating this class into two orders: *Alno-Fraxinetalia*, which includes the floodplain riparian forests of temperate and boreal Europe, and *Populetalia albae*, which groups the Mediterranean and submediterranean riparian forests. In fact, the separation in two orders had been previously proposed by Passarge [13], Dierschke [9], and more recently reiterated by Biurrun et al. [14].

According to Biondi et al. [15,16], the Italian riparian woods are mainly included in the *Salici purpureae-Populetea nigrae* class and in the *Populetalia albae* order, which comprises several alliances: *Populion albae*, *Alno-Quercion roboris*, *Osmundo regalis-Alnion glutinosae*, *Alnion incanae*, *Platanion orientalis*, *Carici remotae-Fraxinion oxycarpae*, *Ligustro vulgaris-Alnion glutinosae*. Within this class, the riparian forests dominated by *A. glutinosa*, subject of our study, are generally included in the *Osmundo-Alnion* or *Ligustro vulgaris-Alnion glutinosae* alliance. The *Osmundo-Alnion* (Br.-Bl. et al. 1956) Dierschke et Rivas-Martínez in Rivas-Martínez 1975 includes the oceanic vegetation dominated by *A. glutinosa* and *Fraxinus angustifolia*, mainly distributed in the Iberian Peninsula and composed by species with Atlantic distribution and Iberian endemisms [17]; it is divided into two sub-alliances: *Osmundo-Alnenion*, with Iberian distribution [18], and *Hyperico hircine-Alnenion glutinosae*, with Tyrrhenian distribution [19,20]. The *Ligustro vulgaris-Alnion glutinosae* includes riparian *Alnus glutinosa*-rich communities of the lowland-hilly belt of northern Italy to the montane one of central-southern Italy [16].

A. glutinosa communities are also interesting from a phytogeographical point of view, considering that this paleotemperate species found refuge in the Mediterranean area during the Quaternary coldest periods. It is likely that many populations have remained permanently isolated in the Mediterranean since the last glacial maximum [21,22], and therefore the postglacial repopulation of Europe would have taken place from refugia located further North of the area under investigation.

The aim of this study is to provide an overview of the riparian wood communities dominated by *A. glutinosa* in Italy and Corsica, along with a review of all syntaxa described so far, in order to provide a coherent phytosociological synthesis taking into account floristic, chorologic, and ecological features.

2. Materials and Methods

2.1. Phytosociological Data

The study followed the Braun–Blanquet phytosociological approach [23,24] according to fundamental and updated concepts recommended by Dengler et al. [25,26], Biondi [27], and Pott [28]. The sparse communities with *A. glutinosa* coverage values less than 20% (+1, 2) have not been taken into consideration for processing. A total of 456 phytosociological relevés per 310 species were processed, of which 377 from the literature and 79 unpublished. Original Braun–Blanquet sampling scale was transformed into the ordinal scale according to Van der Maarel [29]. All the relevés were analyzed using classification and ordination methods.

2.2. Statistical Analysis

A multivariate analysis (Linkage method: Ward's, Distance measure: Bray–Curtis) was applied [30,31]. The optimal number of clusters was identified using the Silhouette index by means of the cluster package in R software [32]. Cluster analysis and ordination of the dataset were performed using PC-ORD 6 software [33]. Ordination (DCA) took into account the bioclimatic variables at 30 s resolution from WorldClim [34]. Quantum GIS software version 3.6 was used for the interpolation of the bioclimatic variables and *A. glutinosa* communities. Diagnostic species of the vegetation units (partitions) was performed by software JUICE [35]. It was determined by means of their fidelity (phi coefficient), and each group was standardized in order to remove dependence of the phi coefficient on unequal sizes; non-significant phi values at $p > 0.05$ were excluded based on Fisher's exact test [36]; species with phi > 0.3 were considered as diagnostic and species with phi > 0.4 as highly diagnostic. Then, the syntaxonomic identification of the obtained partitions was carried out on the basis of diagnostic species, author's own expert knowledge and the literature. For the class description, the list of characteristic species from the literature was reported; for orders and alliances, both the list of statistical species (according to JUICE) and the list of the traditional species from the literature; for associations, the complete lists of diagnostics, constant and dominant species were reported, along with the characteristic species reported by the authors of each association. It is worth noting that in the list of the faithful species are included many species belonging to other syntaxa, such as *Querco-Fagetea*, *Quercetea ilicis* or *Artemisietea vulgaris*; as a result, the real number of true diagnostic species is much lower than the one resulting from the analysis.

2.3. Plant Communities Processed

The processed relevés from the literature were classified into the following syntaxa: *Oenantho crocatae-Alnetum glutinosae*, *Glechomo-Alnetum glutinosae*, *Osmundo-Alnetum glutinosae* for Sardinia [20,37–39], *Circaeo lutetianae-Alnetum glutinosae*, *Polysticho-Alnetum glutinosae*, *Hyperico hircini-Alnetum glutinosae*, *Aro italici-Alnetum glutinosae* for Latium [40–44], *Carici microcarpae-Alnetum glutinosae*, *Carici pallescentis-Alnetum glutinosae*, *Circaeo lutetianae-Alnetum glutinosae*, *Aro italici-Alnetum glutinosae*, *Alno glutinosae-Fraxinetum oxycarpae* for Tuscany [45–53], *Aro italici-Alnetum glutinosae*, *Aro italici-Alnetum glutinosae*, *Alno-Fraxinetum oxycarpae* for Marche [54–56], *Alno-Fraxinetum oxycarpae* for Emilia Romagna [57], *Euphorbio corallioides-Alnetum glutinosae* for Campania [58], *Hyperico hircini-Alnetum glutinosae*, *Angelico sylvestris-Alnetum glutinosae*, *Polysticho-Alnetum glutinosae*, *Euphorbio corallioides-Alnetum glutinosae* for Calabria [55,59–61], *Platano-Salicetum gussonei alnetosum*, *Alnus glutinosa* communities for Sicily [62], *Eupatorio corsici-Alnetum glutinosae*, *Scrophulario auriculatae-Alnetum glutinosae*, *Scolopendrio officinalis-Alnetum glutinosae*, *Athyrio filicis-feminae-Gentianetum asclepiadeae* for Corsica [19,63–65], *Lamio orvalae-Alnetum glutinosae* for Friuli Venezia Giulia, Veneto, Lombardy [66], *Aro italici-Alnetum glutinosae*, *Alnus glutinosa* community for Umbria [67–70], *Aro italici-Alnetum glutinosae* for Abruzzo [71,72].

2.4. Taxonomic, Syntaxonomic Nomenclature and Bioclimatic Classification

Taxonomic nomenclature for native species follows Bartolucci et al. [73], and Pignatti [74–77], while for non-native species follows Galasso et al. [78]. Syntaxonomic classification follows Mucina et al. [12]. The bioclimatic classification follows Pesaresi et al. [79]. The names of syntaxa comply with the International Code of Phytosociological Nomenclature (ICPN) [80].

3. Results and Discussions

Classification of the relevés (cophenetic correlation = 0.577) showed two main vegetation groups (Figures 1 and 2): the first one (cluster A) including the plant communities of the *Osmundo-Alnion* alliance, with an Ibero-Atlantic-Mediterranean distribution, growing in the presence of oligotrophic water and watercourses that do not dry up in summer, in contact with the water table or near springs; the second one (cluster B) including the vegetation of the *Ligustro vulgaris-Alnion glutinosae* alliance, occuring from the lowland-hilly belt of northern Italy to the montane one of central-southern Italy. Within the *Osmundo-Alnion* alliance, two subgroups can be distinguished: the first one includes the thermophilous communities of the *Hyperico hircini-Alnenion glutinosae* sub-alliance, mainly spread in the Tyrrhenian islands (Corsica, Sardinia, Sicily, Elba Island), while the second group includes the mesophilous communities, well differentiated from a floristic and ecological point of view from the *Hyperico hircini-Alnenion glutinosae*, for which a new sub-alliance called *Struthioptero-Alnenion glutinosae*, widespread in central Italy and the Corsican mountains, is here proposed.

The DCA (Figure 3) shows a clear split into three groups. In particular, on the positive side of axis 2 there are the plant communities included in the *Hyperico hircini-Alnenion glutinosae* sub-alliance linked to thermophilous environmental conditions (BIO 4,7,14,17,18), while on the negative side of axis 1 are distributed the communities belonging to *Ligustro vulgaris-Alnion glutinosae* linked to meso-thermophilous climatic conditions (BIO 1,5,6, 8,10,11,15). On the negative side of axis 2, we find the communities included in *Struthioptero-Alnenion glutinosae*, linked to the mesophilous environment's conditions.

Regarding the distribution of the syntaxa showed in Figure 1, it could be interesting to make a comparison with the geographical distribution of the haplotypes known in the literature for *A. glutinosa* [81,82], which indicates how the Calabrian and Corsican populations are isolated and both show affinity with those of North Africa (East Algeria and North Tunisia) [83]. These affinities seem to reflect the paleogoegraphic history of these territories [83–85], which is also reflected in the floristic cortege and the consequent syntaxonomic framework, that is the *Hyperico-Alnenion* suballiance grouping plant communities of Corsica, Sardinia and Sicily. On the contrary, the Calabrian populations isolated from those of northern Italy show a floristic cortege close to northern Italian and European territories, as shown by their inclusion, for the most part, within Ligustro vulgaris-Alnion glutinosae alliance. The synoptic table (Table S1) reveals the differences in floristic composition between the forest types, and their alliances/suballiances, identified on the basis of diagnostic species (i.e., in light grey, the diagnostic and, in dark grey, the highly diagnostic species). A total of 18 plant communities were identified based on silhouette width (Figure 4). The complete syntaxonomical scheme and the description of these plant communities are provided below.

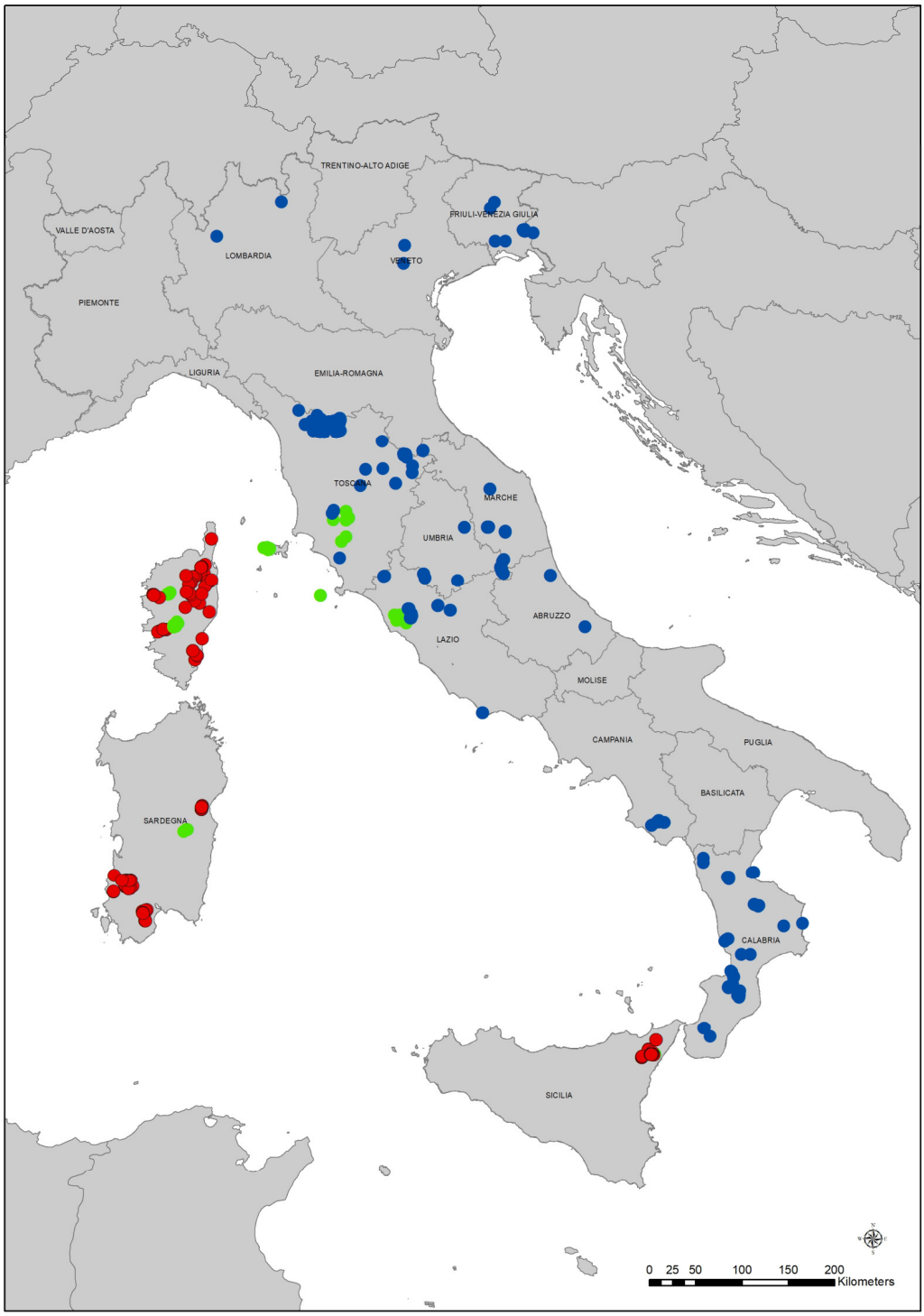

Figure 1. *Alnus glutinosa* communities in Italy and Corsica grouped according to Cluster Analysis (at the level of alliance and sub-alliance). Red dots: *Hyperico hircini-Alnenion glutinosae*; Green dots: *Struthioptero-Alnenion glutinosae*; Blue dots: *Ligustro vulgaris-Alnion glutinosae*.

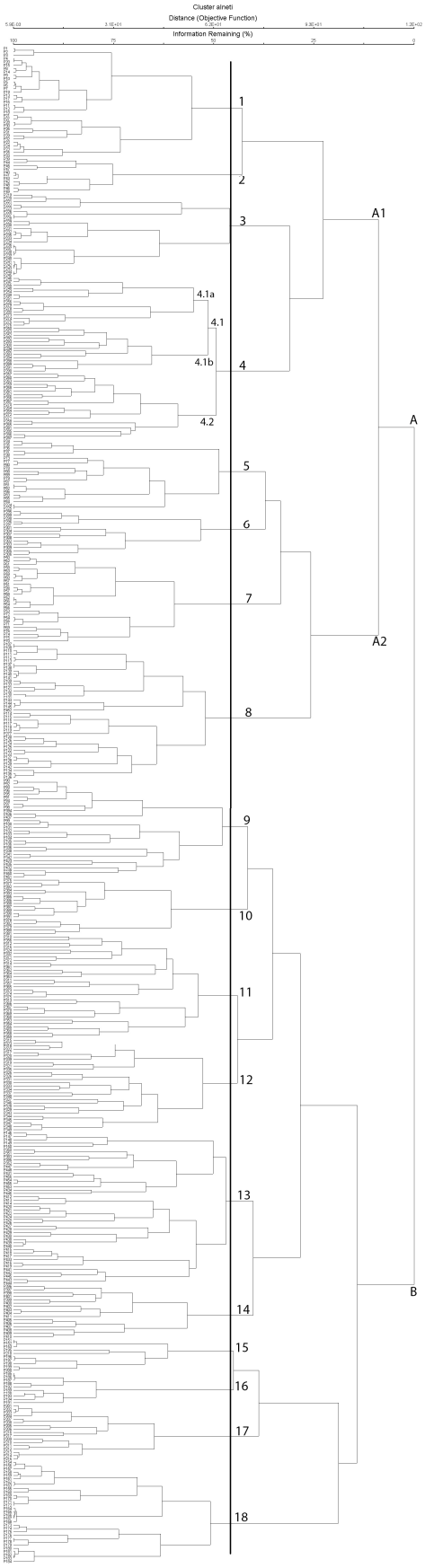

Figure 2. Cluster analysis: A. *Osmundo regalis-Alnion glutinosae*; B. *Ligustro vulgaris-Alnion glutinosae*. A1. *Hyperico hircini–Alnenion glutinosae*; A2. *Struthioptero-Alnenion glutinosae. Plant communities:*

1—*Osmundo-Alnetum glutinosae*; 2—*Oenantho crocatae-Alnetum glutinosae*; 3—*Platano orientalis-Alnetum glutinosae*; 4—*Eupatorio corsici-Alnetum glutinosae*; 5—*Glechomo sardoae-Alnetum glutinosae*; 6—*Gentiano asclepiadeae-Alnetum glutinosae*; 7—*Carici pallescentis-Alnetum glutinosae*; 8—*Carpino betuli-Alnetum glutinosae*; 9—*Aro italici-Alnetum glutinosae*; 10—*Aegopodio podagariae-Alnetum glutinosae*; 11—*Geranio nodosi-Alnetum glutinosae*; 12—*Geranio nodosi-Alnetum glutinosae cornetosum sanguineae*; 13—*Hyperico hircini-Alnetum glutinosae*; 14—*Lamio orvalae-Alnetum glutinosae*; 15—*Polysticho setiferi-Alnetum glutinosae*; 16—*Euphorbio corallioides-Alnetum glutinosae*; 17—*Asperulo taurinae-Alnetum glutinosae*; 18—*Angelico sylvestris-Alnetum glutinosae*.

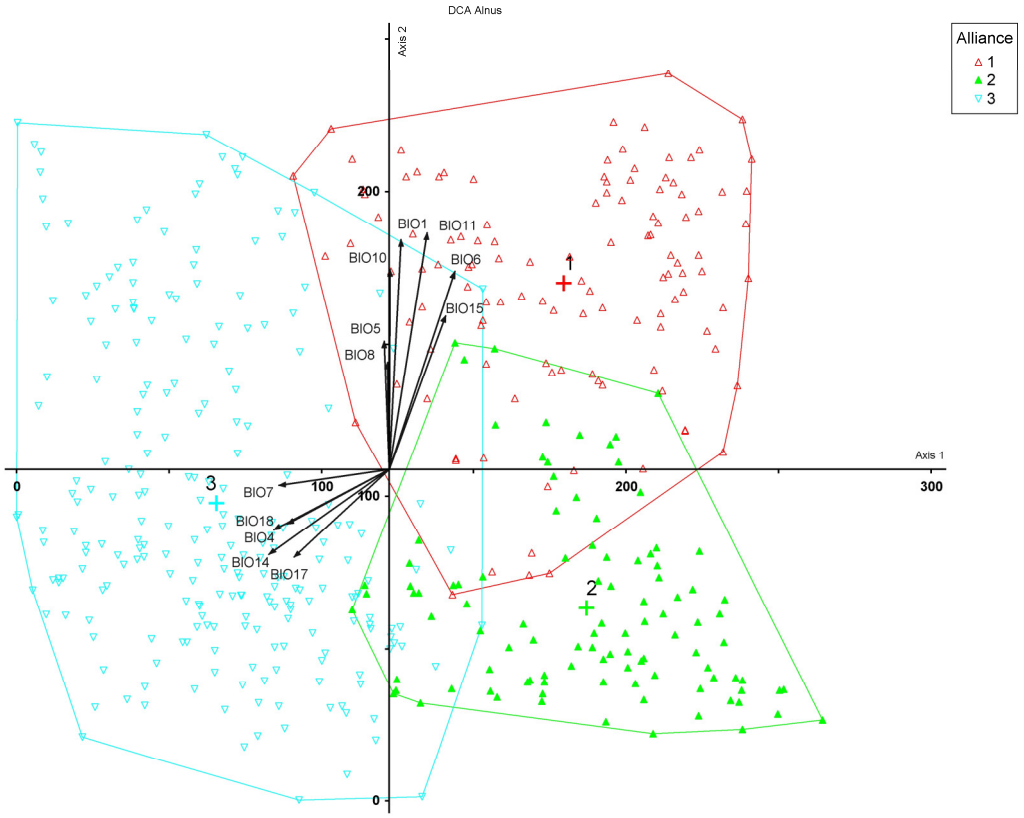

Figure 3. DCA of the sub-alliance and alliance. Total variance ('inertia') in the species data: 4.49. The r squared values of axes 1 and 2 are, respectively, 0.32 and 0.24. Alliance and sub-alliances: 1. *Hyperico hircini-Alnenion glutinosae*; 2. *Struthioptero-Alnenion glutinosae*; 3. *Ligustro vulgaris-Alnion glutinosae*. Bioclimatic variables: BIO1 = Annual Mean Temperature; BIO4 = Temperature Seasonality; BIO5 = Max Temperature of Warmest Month; BIO6 = Min Temperature of Coldest Month; BIO7 = Tem-perature Annual Range; BIO8: Mean Temperature of Wettest Quarter BIO10 = Mean Temperature of Warmest Quarter; BIO11 = Mean Temperature of Coldest Quarter; BIO14 = Precipitation of Driest Month; BIO15 = Precipitation Seasonality; BIO17 = Precipitation of Driest Quarter; BIO18 = Precipitation of Warmest Quarter.

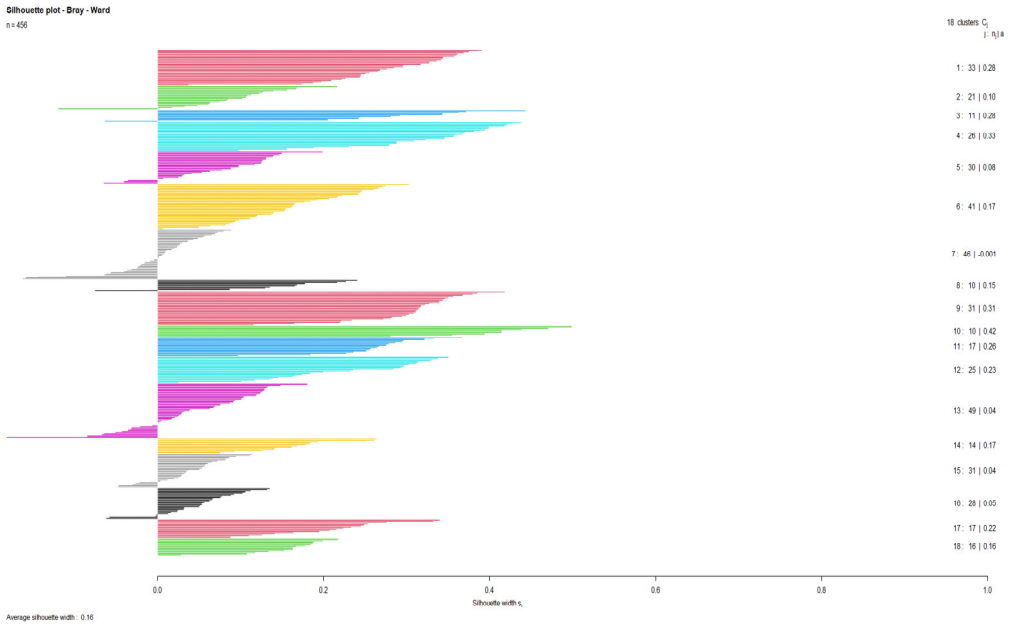

Figure 4. Silhouette width. Plant communities: 1—*Osmundo-Alnetum glutinosae*; 2—*Glechomo sardoae-Alnetum glutinosae*; 3—*Oenantho crocatae-Alnetum glutinosae*; 4—*Carici pallescentis-Alnetum glutinosae*; 5—*Aro italici-Alnetum glutinosae*; 6—*Carpino betuli-Alnetum glutinosae*; 7—*Hyperico hircini-Alnetum glutinosae*; 8—*Polysticho setiferi-Alnetum glutinosae*; 9—*Angelico sylvestris-Alnetum glutinosae*; 10—*Euphorbio corallioides-Alnetum glutinosae*; 11—*Asperulo taurinae-Alnetum glutinosae*; 12—*Platano orientalis-Alnetum glutinosae*; 13—*Eupatorio corsici-Alnetum glutinosae*; 14—*Gentiano asclepiadeae-Alnetum glutinosae*; 15—*Geranio nodosi-Alnetum glutinosae*; 16—*Geranio nodosi-Alnetum glutinosae cornetosum sanguineae*; 17—*Aegopodio podagariae-Alnetum glutinosae*; 18—*Lamio orvalae-Alnetum glutinosae*.

3.1. Syntaxonomical Scheme

Alno glutinosae-Populetea albae P. Fukarek et Fabijanić 1968

Populetalia albae Br.-Bl. ex Tchou 1948

A. *Osmundo regalis-Alnion glutinosae* (Br.-Bl. et al. 1956) Dierschke and Rivas-Martínez in Rivas-Martínez 1975

A1. *Hyperico hircini-Alnenion glutinosae* Dierschke 1975

1-*Osmundo-Alnetum glutinosae* Van den Berghen 1971

2-*Oenantho crocatae-Alnetum glutinosae* Arrigoni et al. 1996

3-*Platano orientalis-Alnetum glutinosae* (Brullo et Spampinato 1990) Sciandrello et al. *nom. nov*. hoc loco

4-*Eupatorio corsici-Alnetum glutinosae* Dierschke 1975

4. *a. typicum*

4. *b. scolopendrietosum nom. nov. hoc loco*

A2. *Struthioptero-Alnenion glutinosae_suball. nov*. hoc loco

5-*Glechomo sardoae-Alnetum glutinosae* Arrigoni 1986

6-*Gentiano asclepiadeae-Alnetum glutinosae* (Litard. and Malcuit 1926) Gamisans 1977 *corr*. Renaux et al. 2019

7-*Carici pallescentis-Alnetum glutinosae* Landi and Angiolini 2010

8-*Carpino betuli-Alnetum glutinosae* (Di Pietro et al. 2010) Sciandrello et al. *nom. nov. hoc loco*

B. *Ligustro vulgaris-Alnion glutinosae* Poldini, Sburlino and Venanzoni 2015 in Biondi et al. 2015

9-*Aro italici-Alnetum glutinosae* Gafta and Pedrotti 1996

10-*Aegopodio podagariae-Alnetum glutinosae* (Blasi and Frondoni 1996) Sciandrello et al. *nom. nov. hoc loco*

11-*Geranio nodosi-Alnetum glutinosae ass. nov*. hoc loco *subass. typicum*

12-*Geranio nodosi-Alnetum glutinosae cornetosum sanguineae subass. nov.*

13-*Hyperico hircini-Alnetum glutinosae* Gafta and Pedrotti 1996
14-*Lamio orvalae-Alnetum glutinosae* Dakskobler 2016
15-*Polysticho setiferi-Alnetum glutinosae* Brullo, Scelsi, Spampinato 2001
16-*Euphorbio corallioides-Alnetum glutinosae* Brullo and Furnari in Barbagallo et al. 1982
17-*Asperulo taurinae-Alnetum glutinosae ass. nov.* hoc loco
18-*Angelico sylvestris-Alnetum glutinosae* Brullo and Spampinato 1997

3.2. Description of the Vegetation

Alno glutinosae-Populetea albae P. Fukarek et Fabijanić 1968
Riparian woods and forests of the Eurosiberian and Mediterranean biogeographic regions
Characteristic species: *Alnus glutinosa*, *Brachypodium sylvaticum*, *Elymus caninus*, *Equisetum hyemale*, *Equisetum telmateia*, *Frangula alnus* subsp. *alnus*, *Humulus lupulus*, *Populus nigra*, *Saponaria officinalis*, *Solanum dulcamara*, *Vitis vinifera* subsp. *sylvestris* [12,86].

Populetalia albae Br.-Bl. ex Tchou 1948
Mediterranean floodplain forests
Characteristic species: *Aristolochia paucinervis*, *A. rotunda*, *Arum alpinum*, *Carex grioletii*, *Circaea lutetiana*, *Fraxinus oxycarpa*, *Hesperis matronalis* subsp. *candida*, *Lamium flexuosum*, *Lathraea clandestina*, *Listera ovata*, *Malus sylvestris*, *Osmunda regalis*, *Polystichum setiferum*, *Populus alba*, *Pyrus pyraster*, *Ficaria verna*, *Salix atrocinerea*, *Stegnogramma pozoi*, *Symphytum tuberosum*, *Ulmus minor*, *Vinca difformis* [86].

A. *Osmundo regalis-Alnion glutinosae* (Br.-Bl. et al. 1956) Dierschke and Rivas-Martínez in Rivas-Martínez 1975 (Cluster A)
Alder, ash, white poplar and willow formations from soft water rivers and streams, mainly composed of species with Atlantic distribution and Tyrrhenian endemics
Holotypus: *Scrophulario-Alnetum glutinosae* Br.-Bl. et al. 1956
Diagnostic species: *Osmunda regalis*, *Carex microcarpa*, *Hypericum hircinum*, *Asplenium onopteris*, *Athyrium filix-femina*, *Cyclamen repandum* subsp. *repandum*, *Eupatorium cannabinum* subsp. *corsicum*, *Fraxinus ornus*, *Ilex aquifolium*, *Oenanthe crocata*, *Pteridium aquilinum* subsp. *aquilinum*, *Smilax aspera*.
Characteristic species (according to the literature): *Arisarum proboscideum*, *Brachypodium sylvaticum*, *Campanula primulifolia*, *Clematis viticella*, *Frangula alnus* subsp. *baetica*, *Holcus grandiflorus*, *Scrophularia laevigata*, *S. scorodonia* [86]; *Carex elata* subsp. *reuteriana*, *Galium broterianum*, *Oenanthe crocata*, *Paradisea lusitanica* [14].

A1. suball. *Hyperico hircini-Alnenion glutinosae* Dierschke 1975 (Cluster A1)
Alder woods of the Circumtyrrhenian area (Sardinia, Corsica, north-eastern Sicily, Tyrrhenian coasts of the Italian peninsula)
Holotypus: *Eupatorio corsici-Alnetum glutinosae* (Litard. 1928) Dierschke 1975
Diagnostic species: *Hypericum hircinum*, *Eupatorium cannabinum* subsp. *corsicum*, *Oenanthe crocata*, *Smilax aspera*, *Ficus carica*, *Mentha aquatica*, *Mentha suaveolens* subsp. *insularis*, *Nerium oleander*, *Phillyrea latifolia*, *Salix atrocinerea* subsp. *atrocinerea*, *Allium triquetrum*, *Buxus sempervirens*, *Euphorbia characias*, *Platanus orientalis*, *Rubus ulmifolius*, *Vitis vinifera*.
Characteristic species (according to the literature): *Hypericum hircinum*, *Carex microcarpa*, *Fraxinus ornus*, *Ficus carica* [19].

1. *Osmundo-Alnetum glutinosae* Van den Berghen 1971 (Cluster 1, Figure 5)

Syn.: *Eupatorio corsici-Alnetum glutinosae* (Litard. 1928) Dierschke 1975 *pro parte*; *Osmundo-Alnetum* (Camarda et al. 1995); *Salici arrigonii-Alnetum glutinosae* (Brullo 1993) Angius and Bacch. 2009
Holotypus: not designated (see synoptic Tab. 3, colum III [87])
Diagnostic species: *Eupatorium cannabinum* subsp. *corsicum*, *Carex microcarpa*, *Cyperus badius*, *Mentha suaveolens* subsp. *insularis*, *Oenanthe crocata*, *Phillyrea latifolia*, *Salix arrigonii*, *Salix atrocinerea* subsp. *atrocinerea*, *Smilax aspera*, *Clematis cirrhosa*, *Euphorbia meuselii*, *Hypericum hircinum*, *Nerium oleander*, *Rhamnus alaternus* subsp. *alaternus*, *Carex divulsa*, *Vitis vinifera*.

Constant species: *Alnus glutinosa*, *Brachypodium sylvaticum*, *Clematis vitalba*, *Dioscorea communis*, *Ficus carica*, *Hedera helix*, *Hypericum hircinum*, *Pteridium aquilinum*, *Rubus ulmifolius*.

Dominant species: *Alnus glutinosa*.

Characteristic species (according to the literature): *Hypericum hircinum*, *Carex microcarpa*, *Euphorbia meuselii*.

Structure and ecology: Edapho-hygrophilous mesowoods (10–20 m high) widespread along oligotrophic rivers and streams, from the sea level up to 800 m of elevation. It is a calcifuge formation, linked to moist sandy to gravelly soils, in the Mediterranean oceanic pluviseasonal bioclimate, with thermotype ranging from the thermomediterranean to the mesomediterranean and ombrotypes between the lower subhumid and the lower humid. Floristically, the tree layer is characterized by the dominance of *A. glutinosa* with low cover values of *Salix atrocinerea* subsp. *atrocinerea* and/or, in the south-westernside of Sardinia, of the endemic *Salix arrigonii*. The shrubby layer is mainly represented by *Hypericum hircinum* subsp. *hircinum*, *Erica terminalis*, *Eupatorium cannabinum* subsp. *corsicum* and *Euphorbia meuselii*, while the herbaceous layer is characterized by several hygrophilous Tyrrhenian endemic plants, such as *Carex microcarpa*, *Mentha suaveolens* subsp. *insularis*, and *Bellium bellidioides*.

Distribution: With the exception of the Gennargentu massif and the Marghine-Goceano chain, it is common on all the siliceous substrata of Sardinia. It is especially representative of the riparian formations of the Gallurese (NE Sardinia) and the Sulcitano-Iglesiente (SW Sardinia) biogeographical sectors [20].

Landscape context: It is part of the calcifuge and oligotrophic Sardinian geosigmetum of the thermomediterranean and mesomediterranean bioclimatic belts [88]. It is in contact with the climatophilous holm-oak and edaphophilous cork-oak woods of the *Quercetalia ilicis*.

Notes: These riparian woods are characterized by a high percentage of Cyrno-Sardinian endemics. In southern Sardinia, the presence of different *taxa* belonging to the genus *Salix* enabled to distinguish two subassociations: *salicetosum atrocinereae* and *salicetosum arrigonii* [20].

2. *Oenantho crocatae-Alnetum glutinosae* Arrigoni et al. 1996 (Cluster 2)

Holotypus: Rel. 58, Tab. 4 [38].

Diagnostic species: *Adiantum capillus-veneris*, *Allium subhirsutum*, *Allium triquetrum*, *Bellium bellidioides*, *Bromus sterilis*, *Catapodium rigidum*, *Cynosurus effusus* (*C. glacilis*, *C. elegans*), *Dittrichia viscosa*, *Euphorbia semiperfoliata*, *Helleborus lividus* subsp. *corsicus*, *Hordeum murinum*, *Leucojum aestivum*, *Mentha aquatica*, *Mentha suaveolens* subsp. *insularis*, *Nerium oleander*, *Oenanthe crocata*, *Parietaria judaica*, *Phillyrea latifolia*, *Salix atrocinerea* subsp. *atrocinerea*, *Torilis africana*, *Clematis cirrhosa*, *Cyclamen repandum* subsp. *repandum*, *Geranium purpureum*, *Smilax aspera*.

Constant species: *Alnus glutinosa*, *Brachypodium sylvaticum*, *Clematis vitalba*, *Fraxinus ornus*, *Hedera helix*, *Rubus ulmifolius*.

Dominant species: *Alnus glutinosa*.

Characteristic species (according to the literature): *Oenanthe crocata*, *Euphorbia semiperfoliata Mentha suaveolens* subsp. *insularis*, *Helleborus lividus* subsp. *corsicus*.

Structure and ecology: Edapho-hygrophilous mesowoods (10–20 m high) present along on bedrock temporary rivers and streams submitted to high drought, from the sea level up to 200 m of elevation. It is linked to moist sandy to gravelly soils in the mediterranean oceanic pluviseasonal bioclimate with a thermomediterranean thermotype and ombrotypes between the lower dry and the lower subhumid. Floristically, the tree layer is characterized by the dominance of *A. glutinosa* with low cover values of *Nerium oleander*, *Salix atrocinerea* subsp. *atrocinerea* and *Vitex agnus-castus*. The shrubby layer is mainly represented by *Hypericum hircinum* subsp. *hircinum*, and *Euphorbia semiperfoliata*, while in the herbaceous layer there is a rich compendium of thermo-hygrophilous plants, such as *Oenanthe crocata*, *Parietaria judaica*, *Hordeum murinum* and *Torilis africana*.

Distribution: At the state of the art, it has been described only for the siliceous outcrops of "Sa Pruna" in territory of Dorgali (CE Sardinia). However, it cannot be excluded that some of the uninvestigated alder formations, especially along the eastern coastal strip

of Sardinia (from the South of Sarrabus to the North of Gallura), can be included in this association.

Figure 5. Plant communities and diagnostic species of the *Alnus glutinosa* riparian woodlands (**1**) in Sardinia: (**2**) *Hypericum hircinum*, characteristic species of the suball. *Hyperico hircini-Alnenion glutinosae*; (**3**,**4**) *Osmundo-Alnetum glutinosae* (Rio Leni, Iglesiente—Sardinia); (**5**) *Glechomo sardoae-Alnetum glutinosae* (Rio Correboi, in the Gennargentu Mounts—Sardinia); (**6**) *Aquilegia nugorensis*, plant species of the *Glechomo sardoae-Alnetum glutinosae*; (**7**,**8**) *Glechomo sardoae-Alnetum glutinosae* (Gennargentu Mounts—Sardinia). Photo credits: O. Caldarella (**1**,**2**), L. Gianguzzi (**5**), G. Bacchetta (**3**,**4**,**6**–**8**).

Landscape context: It belongs to the calcifuge and oligotrophic Sardinian geosigmetum of the thermomediterranean bioclimatic belt, which includes the vegetation succession, from the coastal associations of the *Nerio-tamaricetea* to less thermophylous formations of the *Alno glutinosae-Populetea albae* [88]. It is often in contact with the climatophilous holm-oak woods of the *Quercetalia ilicis*.

Notes: Even though this work confirms the differentiation of this communities from the more widespread *Osmundo-Alnetum glutinosae* association, further investigations are needed to better define their distribution and ecological delimitations.

3. *Platano orientalis-Alnetum glutinosae* (Brullo et Spampinato 1990) Sciandrello et al. *nom. nov. hoc loco* (Cluster 3, Figure 6)

Syn.: *Platano-Salicetum gussonei* Brullo et Spampinato 1990 subass. *alnetosum glutinosae* Brullo et Spampinato 1990

Holotypus: Rel. 14, Tab. 3 [62].

Diagnostic species: *Agrostis castellana*, *Anthriscus nemorosa*, *Clinopodium arundanum*, *Euphorbia characias*, *Holcus lanatus* subsp. *lanatus*, *Mentha suaveolens*, *Platanus orientalis*, *Salix gussonei*, *Asparagus acutifolius*, *Epilobium parviflorus*, *Eupatorium cannabinum*, *Hypericum hircinum*, *Lamium flexuosum*, *Tussilago farfara*.

Constant species: *Alnus glutinosa*, *Brachypodium sylvaticum*, *Carex pendula*, *Clematis vitalba*, *Hedera helix* subsp. *helix*, *Mycelis muralis*, *Polystichum setiferum*, *Rubus ulmifolius*, *Viola alba* subsp. *dehnhardtii*.

Dominant species: *Alnus glutinosa*.

Characteristic species: *Salix gussonei*

Structure and ecology: This riparian wood grows on siliceous substrata (phyllites, gneiss, vulcanite) along the rivers of more or less recessed deep valleys, scattered in the mountain belt at 400–800 m of altitude or in correspondence of the intermediate stretches of rivers ("fiumare"). It is circumscribed to the riparian environments, featured by a very humid and fresh micro-climate, linked to thermomediterranean and mesomediterranean bioclimatic belts. Floristically, the tree layer is characterized by the dominance of *Alnus glutionsa* with low cover values of *Platanus orientalis*, the shrubby layer from *Hypericum hircinum* subsp. *majus, Sambucus nigra, Nerium oleander* and *Ficus carica*, while the herbaceous layer is characterized by a pool of hygrophilous-calcifuge ferns, such as *Polystichum setiferum*, *Dryopteris affinis*, *Anthyrium filix-femina*, *Osmunda regalis*, as well as *Brachypodium sylvaticum*, *Carex pendula*, *Viola alba* subsp. *dehnhardtii*, *Lamium flexuosum*, *Agrostis castellana*, etc. Furthermore, the cenosis is enriched with some lianas, such as *Clematis vitalba*, *Hedera helix*, *Rubus ulmifolius*, *Asparagus acutifolius*, and *Dioscorea communis* (Table 1).

These riparian woods are characterized by the clear dominance of *A. glutinosa*, linked to ravine environments and to narrow floodplains of perennial waterways that flow in the high-hilly belt, along the bottom of deep valleys, with a somewhat humid and cool microclimate. It is a forest vegetation with closed and continuous structure, with coverage close to 100% and heights even over 20 m, and with a rather sparse herbaceous layer. In addition to the presence of the ferns mentioned previously, the coenosis is enriched with some meso-hygrophilous species, such as *Fraxinus ornus*, *Ficus carica*, *Sambucus nigra*, *Carex pendula*, and *Lamium pubescens*.

Distribution: This community is localized in the Peloritani Mountains (Eastern-Sicily), in particular in the upper part of the catchment area of the Fiumara d'Agrò, in the territory of Antillo (Torrente Fonderia, C.de Pianammare, Rosignolo, Pinazzo, etc.), S. Paolo river (Francavilla di Sicilia), Alcantara river. Along the waterways on the Tyrrhenian side of the Peloritani Mounts, there are residual and point-like locations, particularly in Fiumara Madridi (Fondachelli Fantina) and in the Mela Torrent (S. Lucia del Mela), which show floristically impoverished fragments.

Landscape context: In optimal conditions, the association takes catenal contact with the thermophilous deciduous oak woods of the *Quercetalia ilicis*. This coenosis constitutes the most structured aspect of an edapho-hygrophilous and umbrophilic series, which outlines large sections of waterways in the high-hilly part, in particular when they flow on the bottom of fresh and wet, deepvalleys. Along the riverbed, it can come into contact with the *Platano-Salicetum gussonei* Brullo and Spampinato 1990, on alluvial accumulations located in the most open part of the waterstreams, in particular in the larger loops or in the downstream part; on the steep, metamorphic slopes that characterize this territory, they are connected on a large scale, with the climatic series of the *Erico-Querco virgilianae* sigmetum [89].

Notes: The Peloritani district coincides with the north-eastern part of Sicily, which is characterized by the occurrence of several exclusive endemic taxa [84,90,91]. The riparian woodland communities of the Peloritani (Sicily), together with the *Alnus glutinosa* communities of Algeria and Tunisia, can be considered among the southernmost formations of the *A. glutinosa* distribution area [22,92]. Therefore, given the particular humidity conditions required, these communities are the most sensitive to climate change. In some contexts of the Peloritani, where the perennial waters become intermittent, we have been recording a slow and progressive replacement of *A. glutinosa* with *Platanus orientalis*, the latter more thermophilic and tolerant to intermittently flowing waters. Previously, *Alnus glutinosa* communities of the north-eastern part of Sicily were included by Brullo and Spampinato [62] in the subassociation *Platano-Salicetum gussonei alnetosum* (*Platanion orientalis* alliance). In relation to the *Alnus glutinosa*-dominance, with very high *A. glutinosa* cover values and floristic composition, we propose a change of position (from subassociation to association), and a change in the syntaxonomic framework from *Platanion orientalis* to *Osmundo-Alnion glutinosae* (Art.26, Art.27).

4.1. ***Eupatorio corsici-Alnetum glutinosae*** (Litard. 1928) Dierschke 1975 (Cluster 4.1a)

Holotypus: Rel. 1, Tab. 1, p. 232 [19].

Diagnostic species: *Eupatorium cannabinum* subsp. *corsicum*, *Buxus sempervirens*, *Mentha aquatica*, *Rosa sempervirens*, *Convolvulus sepium*, *Galium album*, *Populus nigra*, *Salix cinerea*, *Vitis vinifera*, *Laurus nobilis*, *Smilax aspera*, *Viburnum tinus*.

Constant species: *Alnus glutinosa*, *Athyrium filix-femina*, *Brachypodium sylvaticum*, *Clematis vitalba*, *Ficus carica*, *Fraxinus ornus*, *Hedera helix* subsp. *helix*, *Hypericum hircinum*, *Rubus ulmifolius*.

Dominant species: *Alnus glutinosa*.

Characteristic species (according to the literature): *Eupatorium cannabinum* subsp. *corsicum*, *Carex pendula*, *Equisetum arvense*, *Oenanthe crocata*, *Rorippa palustris*.

Structure and ecology: These riparian woods develop at low altitudes (up to about 450 m a.s.l), mainly along watercourses, or stretches of watercourses, with steep slopes, where torrential waters flow in narrow, more or less recessed streambeds. In these systems, where stony or rocky banks predominate, the more or less oligotrophic waters carry coarse sediments, while the presence of fine materials is weak. These woods grow in conditions of Mediterranean macro-bioclimate, Mediterranean main-seasonal oceanic bioclimate, with thermotypes generally ranging from the upper thermomediterranean to the upper mesomediterranean and ombrotypes generally subhumid. These riparian alder woods, more or less narrow, are dominated by *A. glutinosa*, accompanied by *Fraxinus ornus*, sometimes by *Laurus nobilis*. *Buxus sempervirens* and *Ficus carica* can structure the shrub layer. In the herbaceous and liana layer, *Eupatorium cannabinum* subsp. *corsicum*, *Hypericum hircinum*, *Carex microcarpa*, *Osmunda regalis*, *Athyrium filix-femina*, *Clematis vitalba*, and *Dioscorea communis* are common, while the presence of *Polystichum setiferum* is more punctual. The floristic composition of this community is also structured (although moderately) by species belonging to the *Fagetalia sylvaticae* and more sporadically to that of *Quercetea ilicis*.

Distribution: Crystalline Corsica.

Landscape context: It represents the head of the thermo-mesomediterranean series, oligotrophic and edaphohygrophilous, of the *Eupatorium corsici-Alno glutinosae sigmetum*.

Notes: This group includes most surveys of Dierschke [19] attributed to the *Eupatorio corsici-Alnetum glutinosae* (Litard. 1928) Dierschke 1975. It also includes surveys of Gamisans [64] from the Cavu valley, and the Prunelli valley (*Eupatorio corsici-Alnetum glutinosae* Dierschke 1975 *lauretosum nobili* Gamisans 2013).

Erigeron bonariensis and *Platanus hispanica* have been diagnosed by JUICE, but they were excluded from this list because them are invasive species in Corsica (respectively Category Major and Alert) [93].

Table 1. *Platano orientalis-Alnetum glutinosae* (Brullo et Spampinato 1990) Sciandrello et al. nom. nov. hoc loco. Appendix A.

Rel. Numbers	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
Rel. Numbers Cluster	219	220	221	222	223	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245
Rel. Numbers from the literature	12	13	16	14 *	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Area (m2)	50	100	100	100	100	100	100	100	150	150	150	150	100	100	150	100	100	100	100	100	100	100	100	100	100
Aspect	-	-	-	-	-	-	-	-	NE	NW	SE	SE	SE	E	E	E	E	SE	SE	NE	NE	SE	E	E	E
Slope (°)	-	-	-	-	-	-	-	-	8	5	10	10	10	10	5	5	5	5	5	5	5	5	5	5	5
Tree cover (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Shrum cover (%)	-	-	-	-	-	20	40	20	60	50	50	60	60	50	50	60	50	70	60	40	60	50	80	70	80
Herbaceous cover (%)	-	-	-	-	-	-	-	-	40	30	40	40	40	40	50	50	50	30	40	60	40	50	30	40	30
Altitude (m s.l.m.)	380	400	420	450	490	465	466	467	270	285	430	470	490	400	280	442	455	460	458	600	600	576	575	572	570
Richness floristic	7	18	12	11	12	11	20	19	28	20	17	26	23	25	29	27	28	27	29	27	29	30	27	24	27
Char. Ass.																									
Platanus orientalis	2	2	2	2	1	1	2	3	1	1	1	1	2	.	1	1	2	1	+	1	2	+	1	2	1
Char. *Alno glutinosae-Populetea albae* and *Populetalia albae*																									
Alnus glutinosa	5	4	5	4	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Polystichum setiferum	.	.	.	.	.	.	.	.	.	.	+	1	+	1	1	1	+	+	+	2	1	1	1	1	1
Brachypodium sylvaticum subsp. *sylvaticum*	2	3	3	.	1	.	.	.	2	1	2	2	2	2	3	2	3	2	1	2	1	1	+	+	1
Carex pendula	.	.	+	.	.	.	.	.	1	1	.	1	+	.	1	+	+	1	+	+	+	+	1	+	+
Sambucus nigra	.	.	.	.	.	.	.	.	1	1	.	1	2	1	1	2	1	1	+	+	+	.	.	.	.
Populus nigra	.	1	1	+	.	1	2	1	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.
Salix alba	.	.	.	.	.	.	1	.	1	1	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.
Ulmus minor	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	1	1	.	1	.	.	.	.	.	.
Carex remota	.	.	.	.	.	+	+	1	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Salix gussonei	1	+	2	3	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Equisetum telmateia	.	.	.	.	.	.	.	.	.	.	1	.	.	1	1	.	.	.	.	.	.	.	.	.	.
Char. Osmundo regalis-Alnion glutinosae																									
Athyrium filix-femina	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.	.	1	.	+	.	.	.
Osmunda regalis	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Char. Hyperico hircini–Alnenion glutinosae																									
Hypericum hircinum	.	+	2	.	+	.	.	.	+	1	2	2	1	1	1	2	1	3	1	1	2	2	1	1	2
Lamium flexuosum	.	.	.	.	.	1	1	1	1	1	.	+	1	+	.	2	1	+	+	1	+	+	+	1	+
Fraxinus ornus	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1	+	.	.	.	.	+	1	1	1	1
Ficus carica	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1	1	2	1	.	1	+	.	.	1
Other species																									
Rubus ulmifolius	.	2	.	+	1	1	2	1	2	1	2	2	2	1	1	2	2	1	2	1	3	2	2	2	3

Table 1. *Cont.*

Hedera helix subsp. *helix*	.	.	.	.	+	1	+	+	1	1	1	1	2	+	2	1	1	1	2	1	1	2	2	3	2
Eupatorium cannabinum	2	1	.	1	.	.	.	.	+	+	2	1	2	1	1	2	2	2	1	1	1	1	1	+	+
Clematis vitalba	.	.	+	.	.	+	+	.	+	1	.	1	1	.	1	1	2	1	1	2	1	2	1	1	+
Euphorbia characias	.	.	.	+	+	.	+	+	.	.	1	1	1	+	+	+	1	+	+	+	+	.	.	+	+
Mentha suaveolens	.	.	.	.	.	.	.	.	1	+	2	1	1	+	1	.	+	+	+	1	+	+	+	+	+
Holcus lanatus subsp. *lanatus*	.	.	.	.	.	.	.	.	1	+	.	.	+	+	+	+	+	1	1	1	+	1	1	+	+
Mycelis muralis	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	+	1	+	1	1	1	+	+	+	+
Viola alba subsp. *dehnhardtii*	.	.	.	+	+	.	+	+	1	.	+	.	.	.	+	.	.	.	.	1	1	1	+	1	+
Dioscorea communis	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1	1	+	.	+	+	+	+
Pteridium aquilinum subsp. *aquilinum*	.	.	.	.	.	.	.	.	.	.	+	+	.	1	+	+	1	+	+	1	1	+	.	.	.
Equisetum arvense	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	+	1	+	1	1	+	+
Asparagus acutifolius	.	.	.	.	.	.	+	+	+	.	.	1	1	.	.	+	+	.	+	.	.	+	.	.	+
Anthriscus nemorosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	1	2	1	1	+	1	+
Agrostis castellana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	1	1	3	2	1	+	+	+
Asplenium onopteris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	+	+
Tussilago farfara	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	+	+	+	.	1	+	+	+	.	.
Rubia peregrina	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	1	+	+	+	1	+
Adiantum capillus-veneris	.	.	.	.	.	.	.	.	.	.	1	1	+	.	1	1	1	1	+	.	.	.	.	.	.
Equisetum ramosissimum	1	1	1	.	+	.	.	.	+	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.
Allium subhirsutum	.	+	.	.	.	.	.	1	1	1	.	1	.	+	1	.	.	.	.	.	.	.	.	.	.
Scutellaria columnae subsp. *gussonei*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	+	.	+	.	+	.	+
Agrostis stolonifera	.	.	.	.	.	.	.	.	1	.	1	1	+	.	1	.	.	.	.	.	.	.	.	.	.
Clinopodium arundanum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	.	.
Ruscus aculeatus	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+
Nerium oleander	.	.	.	.	.	2	1	2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Allium triquetrum	.	.	.	.	.	.	.	.	1	.	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.
Salix purpurea	.	1	.	1	1	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Parietaria judaica	.	.	.	.	.	.	.	.	.	.	1	1	.	2	+	.	.	.	.	.	.	.	.	.	.
Convolvulus silvaticus	.	.	.	.	.	.	.	.	1	.	.	1	.	1	1	.	.	.	.	.	.	.	.	.	.
Dittrichia viscosa	1	1	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Torilis africana	.	.	+	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Epilobium parviflorus	.	.	.	.	.	.	.	.	.	.	+	+	.	2	+	.	.	.	.	.	.	.	.	.	.
Arum italicum	.	.	.	.	.	.	.	.	.	+	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.
Prunella vulgaris subsp. *vulgaris*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.

Table 1. *Cont.*

Geranium versicolor	.	.	.	.	.	1	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pulicaria dysenterica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.
Stachys sylvatica	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ajuga reptans	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola reichenbachiana	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Galium aparine	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Angelica sylvestris subsp. *sylvestris*	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyclamen repandum subsp. *repandum*	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ficaria verna	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euphorbia meuselii	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Smilax aspera	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa trivialis	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rosa canina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Cirsium creticum subsp. *triumfettii*	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Laurus nobilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Geranium purpureum	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Figure 6. Plant communities and diagnostic species of the *Alnus glutinosa* riparian woodlands in Sicily: (**1**) *Platano-Alnetum glutinosae* (Fiume Alcantara, Tyrrhenian side of the Peloritani Mountains); (**2**) *Salix gussonei*, diagnostic endemic species of the *Platano-Alnetum glutinosae*; (**3**) *Platano-Alnetum glutinosae* (Fiume Alcantara—Ionic side of the Peloritani Mountains); (**4**) *Platano-Alnetum glutinosae* (Fiume Mela—Tyrrhenian side of the Peloritani Mountains); (**5**) *Platanus orientalis*, characteristic species of the *Platano-Alnetum glutinosae*; (**6–8**) *Platano-Alnetum glutinosae* (Antillo—Monti Peloritani) (Photo credits: L. Gianguzzi (**1–8**).

4.1. *Eupatorio corsici-Alnetum glutinosae* (Litard. 1928) Dierschke 1975 ***scolopendrietosum*** *nom. nov. hoc loco* (Cluster 4.1b)

Syn.: *Scolopendrio officinalis-Alnetum glutinosae* Gamisans 2013 subass. *typicum* or *scolopendrietosum*, subass. *populetosum nigrae*; *Scrophulario auriculatae-Alnetum glutinosae* Gamisans 2013 subass. *ficetosum caricae*, subass. *geranietosum nodosi*.

Holotypus: Rel. 258, Tab. 16 [64].

Diagnostic species: *Alnus cordata*, *Buxus sempervirens*, *Cyclamen hederifolium*, *Equisetum arvense*, *Eupatorium cannabinum* subsp. *corsicum*, *Galium album*, *Geranium nodosum*, *Helleborus argutifolius*, *Hypericum hircinum*, *Mentha aquatica*, *M. suaveolens* subsp. *insularis*, *Petasites albus*, *Rosa sempervirens*, *Salix cinerea*, *Scrophularia nodosa*.

Constant species: *Alnus glutinosa*, *Athyrium filix-femina*, *Brachypodium sylvaticum*, *Clematis vitalba*, *Crataegus monogyna*, *Hedera helix*, *Ilex aquifolium*, *Mycelis muralis*, *Polystichum setiferum*, *Pteridium aquilinum*, *Ranunculus lanuginosus*, *Rubus ulmifolius*, *Sambucus nigra*, *Viola reichenbachiana*.

Dominant species: *Alnus glutinosa*.

Characteristic species (according to the literature): *Scolopendrium officinale*, *Scrophularia nodosa*, *Scrophularia auriculata*, *Symphytum bulbosum*, *Adiantum capillus-veneris*.

Structure and ecology: These riparian woods are mostly located in Alpine Corsica (lustrous schists zone) characterized by very complex geological units and they are marked by schists, calcschists, limestones and green rocks (metabasaltes, metagabbros, gabbros, serpentinites). They are structured along watercourses or streams where the streambed is often entrenched within more or less narrow valleys, in an altitudinal belt mainly between 100 and 900 m a.s.l. and seem to be distributed more around a bioclimatic belt characterized by meso-temperate thermotypes (sub-Mediterranean variant) with humid ombrotypes. These riparian forests are dominated by *A. glutinosa*, accompanied in the shrub layer by *Buxus sempervirens*, *Ilex aquifolium*, *Sambucus nigra*, *Corylus avellana*, *Ostrya carpinifolia* and sometimes by *Alnus cordata*. The herbaceous layer is marked by the presence of *Hypericum hircinum*, *Eupatorium cannabinum* subsp. *corsicum* as well as by the high frequency of aerohygrophilous ferns, such as *Athyrium filix-femina*, *Polystichum setiferum*, and accompanied by species of *Fagetalia sylvaticae*.

Distribution: Mainly Alpine Corsica (San Petrone, Tenda and Cap Corse massifs).

Landscape context: Catenal contact with, for example, formations of *Castanea sativa*, *Quercus pubescens*, *Q. ilex*.

Notes: This group includes some relevés of Dierschke [19] attributed to the *Eupatorio corsici-Alnetum glutinosae* (Litard. 1928) Dierschke 1975 and other relevés of Gamisans [64] belonging to the *Scolopendrio officinalis-Alnetum glutinosae* Gamisans 2013 and the *Scrophulario auriculatae-Alnetum glutinosae* Gamisans 2013. These last two syntaxa are attributed by this author to the riparian forests of the San Petrone and Cap-Corse massifs developing on neutro-basic soils. In particular, they are characterized by the absence of *Osmunda regalis*, while there are *Scrophularia auriculata*, *Symphytum bulbosum*, *Scolopendrium officinale*, *Adiantum capillus-veneris*, *Scrophularia nodosa*, *Petasites albus*. On the basis of these floristic and ecological features, Gamisans [64] proposed to gather together these two syntaxa within a new sub-alliance (*Petasito albi-Adiantenion capillus-veneri* Gamisans 2013), which differed from the riparian forests of the *Hyperico hircini-Alnenion glutinosae* developing on acid soils and characterizing crystalline Corsica. These two sub-alliances were grouped together by this author in the *Caricion microcarpae* Gamisans (1968) 1977; *Osmundo regalis-Alnion glutinosae* (Br.-Bl. and al. 1956) Dierschke and Rivas-Martínez was considered here as a West Mediterranean calcifuge unit. This conception was also followed by Reymann et al. [94]. The results of the analyses (clusters) show that the communities of Cluster 4.1a and those of Cluster 4.1b are very similar, signifying the high floristic proximity between the surveys of *Eupatorio corsici-Alnetum glutinosae* (Litard. 1928) Dierschke 1975 and those of *Scolopendrio officinalis-Alnetum glutinosae* Gamisans 2013 and *Scrophulario auriculatae-Alnetum glutinosae*. This similarity leads us to consider this subgroup 4.1b as a subassociation (*Eupatorio corsici-Alnetum glutinosae scolopendrietosum*). This floristic similarity shows the affinity of these communities to the *Osmundo regalis-Alnion glutinosae* and better legitimizes their linkage within this alliance and the *Hyperico hircini-Alnenion glutinosae*. These results are in accordance with Mucina et al. [12], who do not consider the *Caricion microcarpae* and include it as heterotypic synonym for the *Osmundo regalis-Alnion glutinosae*. *Platanus hispanica* was diagnosed by JUICE, but it was removed from this list because it is an invasive species in Corsica (Category: Alert) [93].

A2. ***Struthioptero-Alnenion glutinosae*** *suball. nov. hoc loco* (Cluster A2)

Mesophilous woods of central Italy and the Corsican mountains

Holotypus: *Carpino betuli-Alnetum glutinosae ass. nov. hoc loco*

Diagnostic species: *Struthiopteris spicant*, *Osmunda regalis*, *Athyrium filix-femina*, *Ilex aquifolium*, *Hypericum androsaemum*, *Carex remota*, *Allium pendulinum*, *Anemonoides nemorosa*, *Carpinus betulus*, *Melica uniflora*, *Physospermum cornubiense*, *Quercus ilex*.

Characteristic species: *Struthiopteris spicant*, *Carex pallescens*, *Hypericum androsaemum*, *Ilex aquifolium*, *Stachys sylvatica*, *Gentiana asclepiadea*, *Athyrium filix-femina*, *Lonicera periclymenum*.

5. ***Glechomo sardoae-Alnetum glutinosae*** Arrigoni 1986 (Cluster 5, Figure 5)

Syn.: *Carici microcarpae-Alnetum glutinosae* Foggi, Cartei, Pignotti, Viciani, Dell'Olmo et Menicagli 2006.

Holotypus: Rel. 24, Tab. 8 [37].

Diagnostic species: *Epilobium lanceolatum*, *Osmunda regalis*.

Constant species: *Alnus glutinosa*, *Hedera helix* subsp. *helix*, *Athyrium filix-femina*, *Polystichum setiferum*, *Pteridium aquilinum* subsp. *aquilinum*, *Rubus ulmifolius*.

Dominant species: *Alnus glutinosa*.

Characteristic species (according to the literature): *Epilobium lanceolatum*, *Polystichum setiferum*, *Glechoma sardoa*.

Structure and ecology: Edapho-hygrophilous mesowoods (10–20 m high), that grows on siliceous substrata (granites, granodiorites and metamorphytes) along the rivers of more or less recessed deep valleys. In Sardinia, it is scattered in the mountain belt at 800–1600 m of elevation, while in the Tuscan archipelago it grows in ditches constantly supplied by the water table at elevations between 250 and 600 m a.s.l. They are mainly distributed between meso-mediterranean and temperate submediterranean bioclimates with ombrotypes between the upper subhumid and the lower humid. Floristically, the tree layer is characterized by the dominance of *A. glutinosa* with the scattered presence of *Taxus baccata* and *Ilex aquifolium* in Sardinia, and *Quercus ilex* and *Ostrya carpinifolia* in Tuscany. The shrubby and liana layers are mainly represented by *Hypericum hircinum* subsp. *hircinum*, *Rubus* gr. *ulmifolius* and *Hedera helix*, while the herbaceous layer is characterized by *Carex macrocarpa*, endemic to Sardinia, Corsica and the Tuscan archipelago, and by a pool of hygrophilous-calcifuge ferns, such as *Polystichum setiferum*, *Pteridium aquilinum* subsp. *aquilinum*, *Athyrium filix-femina*, *Carex remota*, *Cystopteris dickieana*, *C. fragilis* and *Dryopteris pallida*. In Sardinia, several Cyrno-Sardinian endemics, such as *Glechoma sardoa*, *Paeonia corsica*, *Aquilegia nugorensis* and *A. barbaricina*, are also characteristic of this community.

Distribution: In Sardinia, it is exclusive to the Gennargentu massif (CE Sardinia), a mountain range that, for its degree of isolation and floristic peculiarities, is considered an independent biogeographical sector [95]. In Tuscany, it occurs in the deep valleys of Monte Capanne on the Island of Elba, and also in the Island of Giglio.

Landscape context: It is part of the calcifuge and oligotrophic Sardinian geosigmetum of the mesotemperate-supratemperate bioclimatic belt and the supramediterranean wet and calcifuge *Galio scabri-Querceto ilicis* geosigmetum [50,88]. In optimal conditions, the association is in contact with the Sardinian climatophilous deciduous oak woods of the *Glechomo sardoae-Quercetum congestae* [96] or more rarely with the edapho-xerophilous microforests of the *Juniperetum nanae* subass. *cerastietosum boissieriani* [61]. Spatial contacts in the Islands of Elba and Giglio are with the climatophilous olm-oak woods referred to as the *Galio scabri-Quercetum ilicis* and with the edafo-hygrophylous woods of the *Polysticho setiferi-Ostryetum carpinifoliae* association.

Notes: This association, characterized by a high percentage of Paleotemperate species and orophilous Cyrno-Sardinian endemics, represents the western-southernmost limit of the *Struthioptero-Alnenion glutinosae* new sub-alliance, which includes the mesophilous plant communities of central Italy, and the Sardinian and Corsican mountains. The conservation interest of this association is also confirmed by the frequent presence of centenary alder trees that characterize some formations with an old-growth character [97]. Otherwise, the

delimitation of this community with the rest of the Cyrno-Sardinian associations is within the suball. *Hyperico hircini-Alnenion glutinosae* is still problematic, and further investigation would therefore be advisable.

6. *Gentiano asclepiadeae-Alnetum glutinosae* (Litard. and Malcuit 1926) Gamisans 1977 *corr*. Renaux et al. (2019) (Cluster 6)

Syn.: *Athyrio filicis-feminae-Gentianetum asclepiadeae* Gamisans 1977 nom. illeg. (Art. 3k, 29b)

Lectotypus: Rel. 14, Tab. 37, Gamisans 1975 and 1977: 174 (subassociation *gentianetosum asclepiadeae* or *typicum*); Subassociation *doronicetosum corsici*, lectotypus: Rel. 2, Tab. 37, Gamisans 1975 and 1977: 174; Subassociation *conopodietosum denudati* Gamisans, holotypus: Rel. 75, Tab. 20.

Diagnostic species: *Acer pseudoplatanus*, *Allium pendulinum*, *Allium ursinum*, *Aquilegia dumeticola*, *Conopodium majus*, *Cyclamen repandum* subsp. *repandum*, *Doronicum corsicum*, *Galium rotundifolium*, *Gentiana asclepiadea*, *Helleborus argutifolius*, *Ilex aquifolium*, *Pinus nigra* subsp. *laricio, Potentilla micrantha*, *Viola riviniana*, *Athyrium filix-femina*, *Cyclamen hederifolium*, *Festuca heterophylla*, *Ficaria verna*, *Mercurialis perennis*, *Moehringia trinervia*, *Oenanthe pimpinelloides*, *Sanicula europaea*, *Saxifraga rotundifolia*, *Solidago virgaurea*.

Constant species: *Alnus glutinosa*, *Carex microcarpa*, *Fraxinus ornus*, *Melica uniflora*, *Ranunculus lanuginosus*.

Dominant species: *Alnus glutinosa*.

Characteristic species (according to the literature): *Gentiana asclepiadea*, *Athyrium filix-femina*, *Oreopteris limbosperma*.

Structure and ecology: These riparian alder woods are distributed along watercourses or stretches of watercourses with a torrential regime, mainly within crystalline Corsica, in an altitudinal belt above 600 m a.s.l up to around 1150 m a.s.l. They seem to be distributed in correspondence of a bioclimatic belt characterized by upper meso-temperate/lower supra-temperate (sub-mediterranean variant) and sometimes lower supramediterranean thermotypes, with humid ombrotype. These more or less sparse riparian woodlands are dominated by *A. glutinosa*, *Fraxinus ornus* and *Acer pseudoplatanus*, which have more discrete cover values, and *Pinus laricio* subsp. *laricio* can be found more rarely. *Ilex aquifolium* is frequent in the shrub layer, and the herbaceous layer is characterized in particular by the presence of *Athyrium filix-femina*, *Gentiana asclepiadea*, *Carex microcarpa*, *Allium ursinum*, together with other species of *Fagetalia sylvaticae*.

Distribution: High valleys of Golu, Tavignanu, Prunelli, Vecchio and valley of Manganellu, etc. (Corsica).

Landscape context: catenal contact with formations of *Fagetalia sylvaticae*, especially forests of *Pinus laricio* subsp. *laricio* and *Fagus sylvatica*.

Notes: This association was previously included in *Hyperico hircini-Alnenion glutinosae* Dierschke 1975 where it represented the communities growing at the highest altitudes [64,65,94]. Three subassociations were distinguished there. The inclusion of this association in the new suballiance proposed in this paper (*Struthioptero-Alnenion glutinosae*) reflects the mesophilous conditions in which these communities develop, which are marked by the high frequency of *Fagetalia sylvaticae* species. Gamisans (*op.cit*) also pointed out the high frequency of these species, so the question of whether this association belongs to these units could be raised. No subassociation has been highlighted by the analysis.

7. *Carici pallescentis-Alnetum glutinosae* Landi and Angiolini 2010 (Cluster 7, Figure 7)

Holotypus: Rel. 13, Tab. III [51].

Diagnostic species: *Anemonoides nemorosa*, *Brachypodium rupestre*, *Castanea sativa*, *Hypericum androsaemum*, *Ilex aquifolium*, *Isolepis cernua*, *Juncus articulatus* subsp. *articulatus*, *Lysimachia vulgaris*, *Molinia arundinacea*, *Osmunda regalis*, *Physospermum cornubiense*, *Rubus hirtus*, *Sorbus torminalis*, *Struthiopteris spicant*, *Teucrium scorodonia*, *Frangula alnus* subsp. *alnus*, *Fraxinus ornus*, *Myosotis scorpioides*, *Prenanthes purpurea*.

Constant species: *Alnus glutinosa*, *Athyrium filix-femina*, *Brachypodium sylvaticum*, *Carex remota*, *Hedera helix*, *Pteridium aquilinum*.

Dominant species: *Alnus glutinosa*.

Characteristic species (according to the literature): *Struthiopteris spicant*, *Carex pallescens*, *Hypericum androsaemum*, *Ilex aquifolium*.

Structure and ecology: *A. glutinosa* woods, with *Fraxinus ornus*, *Castanea sativa* and *Populus tremula*. The shrub layer is dominated by *Ilex aquifolium*, *Hypericum androsaemum* and, less frequently, by *Frangula alnus*, *Dryopteris affinis*, *Rubus hirtus* and *Salix cinerea*. The herbaceous layer is dominated by *Osmunda regalis*, *Athyrium filix-femina*, *Struthiopteris spicant*, *Carex remota* and *C. pallescens*. Together with entities belonging to the genus *Sphagnum* sp. pl., these species highlight the meso-oligotrophic and calcifugous character of the coenosis [98,99]. The elevated abundance of *Molinia arundinacea* and/or the presence of *Phragmites australis* in some relevés, on the other hand, indicates a more heliophytic nature. On soils where the slope increases or even in the spring swamps where the surfacing water decreases, these woods undergo successive stages of degeneration with the substitution of some hygrophilous species such as *Struthiopteris spicant* and *Molinia arundinacea* with the less hygrophilous ones such as *Pteridium aquilinum* [100]. This vegetation is linked to meso-oligotrophic and acidophilous riparian environments in ditches and streams constantly supplied by the water table, and with spring swamps connected to them. These environments can be found in hilly mountainous areas between 150 and 600 m a.s.l. characterized, according to Pesaresi et al. [79], by a Mediterranean oceanic pluviseasonal bioclimate and, only marginally (Apuan Alps phytocoenoses), by a temperate oceanic (submediterranean) one; the thermotype ranges from the lower mesomediterranean to the lower supratemperate and ombrotypes between the lower subhumid and the lower humid.

Distribution: Tyrrhenian side of central Italy (Monte Pisano, Poggio di Montieri, hills around the Farma-Merse basin and Monte Leoni and, in a marginal form, Apuan Alps; the association is probably present also in northern Latium) [51,101].

Landscape context: The phytocoenoses identified in southern Tuscany are in contact with woods assigned to *Physospermo cornubiensis-Quercetum petraeae* Oberdorfer et Hofmann 1967 [102] attributable to the alliance *Erythronio-Quercion petraeae* Ubaldi (1988) 1990 (*Quercetalia pubescenti-petraeae* Klika 1933 *corr*. Moravec in Béguin et Theurillat 1984).

Notes: The Mediterranean and Eurasian chorotypes are dominant. The frequency of species associated with temperate climates (e.g., *Anemone nemorosa*, *Struthiopteris spicant* and *Carex pallescens*), the absence of the Mediterranean *Hypericum hircinum*, typical of the suballiance *Hyperico hircini-Alnenion glutinosae* substituted by *H. androsaemum*, an oceanic species, and the participation of Mediterranean species, place this association on the boundary between the Mediterranean and Eurasian phytogeographic regions [103].

8. *Carpino betuli-Alnetum glutinosae* (Di Pietro et al. 2010) Sciandrello et al. *nom. nov. hoc loco* (Cluster 8, Figure 7)

Syn.: *Polysticho-Alnetum glutinosae* [43]; *Polysticho-Alnetum glutinosae* [44].

Holopypus: Rel. 1, Tab. 12 [43].

Diagnostic species: *Carpinus betulus*, *Quercus petraea*, *Dactylorhiza maculata*, *Dioscorea communis*, *Lonicera caprifolium*.

Constant species: *Acer campestre*, *Alnus glutinosa*, *Athyrium filix-femina*, *Brachypodium sylvaticum*, *Carex pendula*, *Carex remota*, *Circaea lutetiana*, *Clematis vitalba*, *Corylus avellana*, *Fraxinus ornus*, *Hedera helix* subsp. *helix*, *Melica uniflora*, *Mycelis muralis*, *Osmunda regalis*, *Polystichum setiferum*, *Ranunculus lanuginosus*, *Rubus ulmifolius*, *Ruscus aculeatus*, *Viola reichenbachiana*.

Dominant species: *Alnus glutinosa*.

Characteristic species (according to the literature): *Polysticum setiferum*, *Athyrium filix-femina*, *Struthiopteris spicant*, *Ilex aquifolium*.

Structure and ecology: ravine woodlands which develop on limited spaces in the bottom of the small gorges, on gentle slopes at lower altitude (150–400 m a.s.l.) linked to Mediterranean lower mesomediterranean thermotype and upper subhumid ombrotype. *Carpino betuli-Alnetum glutinosae* is strongly related to volcanic (ignimbrites) litotypes. These are multilayer communities organised generally on two levels: higher tree level (until 20 m),

constantly represented by *A. glutinosa*, lower tree level (7–8 m), while shrubs and herbaceous layers appear extremely variable. Locally, it is possible to find stands with high wood diversity, in which there is participation of *Fagus sylvatica*, *Quercus petraea*, and *Q. cerris*. Generally, these are facies where the spatial contact with mesophitic deciduous formations is quite evident. These events are favored by particular morphological conditions, such as topographic variability and steep slopes. From a chorological point of view, the new association is characterized by the predominance of Eurasiatic species, followed by the Mediterranean and Boreal ones. This character is also confirmed for other plant communities of the sub-coastal district of the Tuscan-Latium Maremma, as a result of the marked interpenetration between the temperate and mediterranean biocore; this is evidence widely highlighted in the literature [51,104–107].

Figure 7. Plant communities and diagnostic species of the *Alnus glutinosa* riparian woodlands in Italian Peninsula: (**1**) *Osmunda regalis*, in the *Carici pallescentis-Alnetum glutinosae* (Toscana); (**2**) *Carpino betuli-Alnetum glutinosae* (Mignone, Canale Monterano—Lazio); (**3**,**4**) *Euphorbio-Alnetum glutinosae*, respectively, in Sila Grande and Torrente Vasi (Calabria); (**5**) *Euphorbia corallioides*, characteristic species of the *Euphorbio-Alnetum glutinosae* (Calabria); (**6**) *Angelico sylvestris-Alnetum glutinosae* (Torrente Sarmento, Pollino Mounts—Calabria); (**7**,**8**) *Polysticho-Alnetum glutinosae*, respectively, in the Serre Calabre and Torrente Ferraino (Aspromonte—Calabria); Photo credits: O. Caldarella (**1**), M. Cutini (**2**), G. Spampinato (**3**), L. Gianguzzi (**4**,**5**,**7**,**8**).

Distribution: Northern Latium.

Landscape context: catenal contact with extrazonal mesophytic formations (*Fagetalia sylvaticae*), locally dominated by *Quercus cerris* [44,108], in a complex mosaic characterized by the transition between Mediterranean and temperate biocora.

Notes: Some relevés of this association were previously considered as belonging to the *Polysticho-Alnetum glutinosae* association, described by Di Pietro et al. [43] in the Tolfa Mountains (northern Latium). Similarly, the same can be said for relevés carried out in the same district, reported by Cutini et al. [44] to the *Polysticho-Alnetum glutinosae* association described in Aspromonte (southern Calabria) [61].

B. *Ligustro vulgaris–Alnion glutinosae* Poldini, Sburlino and Venanzoni 2015 in Biondi et al. 2015 (Cluster B)

Riparian meso-thermophilous forests of the submediterranean regions of the Northern and Central Apennine Peninsula.

Holotypus: *Aro italici-Alnetum glutinosae* Gafta and Pedrotti 1996 [55] (p. 414)

Diagnostic species: *Aegopodium podagraria*, *Cornus sanguinea*, *Rubus caesius*, *Stachys sylvatica*, *Urtica dioica*, *Alliaria petiolata*, *Angelica sylvestris* subsp. *sylvestris*, *Chaerophyllum temulum*, *Euonymus europaeus*, *Galium aparine*, *Geranium versicolor*, *Geum urbanum*, *Ligustrum vulgare*, *Petasites hybridus*, *Salix alba*, *Sambucus nigra*, *Solanum dulcamara*.

Characteristic species (according to the literature): *Bryonia dioica*, *Chaerophyllum temulum*, *Equisetum telmateja*, *Ligustrum vulgare*, *Petasites hybridus*, *Populus alba*, *P. nigra*, *Robinia pseudacacia* [16].

9. *Aro italici-Alnetum glutinosae* Gafta and Pedrotti 1996 (Cluster 9)

Syn.: *Alno-Fraxinetum oxycarpae* Tchou 1946 (Francalancia and Macconi 1994)

Holotypus: Rel. 1, p. 414 [55]

Diagnostic species: *Alliaria petiolata*, *Bryonia dioica*, *Carduus personata*, *Cornus sanguinea*, *Elymus caninus*, *Heracleum sibiricum* subsp. *ternatum*, *Lonicera xylosteum*, *Pulmonaria vallarsae*, *Aegopodium podagraria*, *Euonymus europaeus*, *Myosoton aquaticum*.

Constant species: *Acer campestre*, *Alnus glutinosa*, *Brachypodium sylvaticum*, *Clematis vitalba*, *Corylus avellana*, *Geranium robertianum*, *Geum urbanum*, *Ranunculus lanuginosus*, *Sambucus nigra*, *Stachys sylvatica*, *Urtica dioica*.

Dominant species: *Alnus glutinosa*.

Characteristic species (according to [54]: *Alliaria petiolata*, *Angelica sylvestris* subsp. *sylvestris*, *Asarum europaeum*, *Adoxa moschatellina* subsp. *moschatellina*, *Cardamine bulbifera*, *Heracleum sibiricum* subsp. *ternatum*, *Lolium giganteum*, *Stachys sylvatica*.

Structure and ecology: These riparian woods occur along the middle-upper section of some river basins in the southern part of the Marche region, at altitude ranging between 560 and 820 m a.s.l., at the edge of fast-flowing watercourses, on constantly moist substrates consisting mainly of coarse alluvial deposits (pebbles mixed with sand). They are characterized by high cover values of black alder, which forms quite a monospecific tree layer, with sporadic and sparse presence of *Populus alba*, *P. nigra*, *Salix alba*. The shrub layer is mainly formed by species of *Rhamno-Prunetea*, such as *Crataegus monogyna*, *Prunus spinosa*, *Rubus caesius*, *Rubus ulmifolius*, whose presence is probably due to a long-time coppice management [54]. The herbaceous layer is well developed and rich in species; the most frequent and abundant are *Alliaria petiolata*, *Angelica sylvestris*, *Brachypodium sylvaticum*, *Petasites hybridus*, *Pulmonaria vallarsae* subsp. *Apennina*, *Lolium giganteum*, *Stachys sylvatica*. The level of anthropic disturbance is highlighted by the presence (with, sometimes, high frequence and meaningful cover values), of synanthropic species such as *Urtica dioica*, *Chaerophyllum temulum*, and *Stellaria media*. These communities have, at present, considerably reduced and fragmented extent. The reduction in area is due to the expansion of cultivated areas, in some cases up to the river fringes. According to Pesaresi et al. [79], the area where these communities are distributed is characterized by a thermotype that ranges from lower to upper supratemperate and upper humid ombrotypes.

Distribution: Marche, Lazio, Toscana, Umbria.

Landscape context: Catenal contact with *Populus alba* and *P. nigra* communities or with mesophytic formations locally dominated by *Quercus cerris* and *Fagus sylvatica* [54].

Notes: These communities had been previously attributed, along with other similar formations found in Liguria and in central Italy, to the association *Alno-Fraxinetum oxycarpae* Tchou 1946 [46,54,69,109–111], even if most of these authors have expressed several doubts about the real attribution to this association described by Tchou [112] for Southern France, due to both the floristic composition and, in particular, the absence of *Fraxinus oxycarpa* (see also [40]).

10. ***Aegopodio podagrariae-Alnetum glutinosae*** (Blasi and Frondoni 1996) Sciandrello et al. *nom. nov. hoc loco* (Cluster 10)

Syn.: *Circaeo lutetianae-Alnetum glutinosae* Blasi and Frondoni 1996.

Holopypus: Rel. 10, Tab. 1 [40].

Diagnostic species: *Acer campestre*, *Anthriscus sylvestris*, *Parietaria officinalis*, *Plantago major*, *Poa annua*, *Veronica montana*, *Aegopodium podagraria*, *Alliaria petiolata*, *Asplenium scolopendrium* subsp. *scolopendrium*, *Chaerophyllum temulum*, *Chelidonium majus*, *Euphorbia amygdaloides*, *Lamium maculatum*, *Poa sylvicola*, *Primula vulgaris*, *Ranunculus lanuginosus*, *Ruscus aculeatus*, *Silene baccifera*, *Ulmus minor*.

Constant species: *Alnus glutinosa*, *Brachypodium sylvaticum*, *Circaea lutetiana*, *Clematis vitalba*, *Crataegus monogyna*, *Geum urbanum*, *Hedera helix* subsp. *helix*, *Melica uniflora*, *Mycelis muralis*, *Rubus ulmifolius*, *Sambucus nigra*, *Urtica dioica*, *Viola reichenbachiana*.

Dominant species: *Alnus glutinosa*, *Hedera helix* subsp. *helix*, *Sambucus nigra*.

Characteristic species (according to the literature): *Alnus glutinosa*, *Circaea lutetiana*, *Carex pendula*, *Carex remota*, *Stachys sylvatica*.

Structure and ecology: Mesophitic riparian woodland of limited altitudes, located at the bottom of ravines, generally on deep soils characterized by fine sediments. They occur at an altitude between 150 and 800 m, in territories with a Mediterranean lower mesomediterranean thermotype and upper subhumid ombrotype. Sporadically found in riverbeds with abundant coarse debris [40]. The arboreal layer, always with high coverages (>90%), is characterized by *A. glutinosa* and can be locally accompanied by *Carpinus betulus* and *Corylus avellana*. The shrub layer is generally present and abundant, and it is characterized by *Corylus avellana* and *Ulmus minor*. The herbaceous layer is characterized by *Aegopodium podagraria*, *Circaea lutetiana*, *Carex pendula*, *Stachys sylvatica*, *Viola reichenbachiana*, *Melica uniflora*. From a chorological point of view, the *Aegopodio-Alnetum* glutinosae is a vegetation characterized by the interpenetration between species with Eurasian and Pontic (eastern) distribution, locally with a significant presence of the wide distribution type.

Distribution: Northern Latium.

Landscape context: Catenal contact with extrazonal mesophytic formations (*Fagetalia sylvaticae*), locally dominated by *Quercus cerris* and *Carpinus betulus* [44], in a tension area characterized by complex mosaics due to the transition between Mediterranean and temperate biocora.

Notes: communities strongly conditioned by anthropogenic disturbance. Generally, these are populations of limited extension, structurally present also in the bushes form. *Robinia pseudoacacia* has been diagnosed by JUICE, but it has been removed from the list of diagnostic species because it is an invasive alien species.

These communities have been described by Blasi and Frondoni [40] as *Circaeo lutetianae-Alnetum glutinosae*. In fact, *Circaeo-Alnetum* has to be considered an illegitimate name due to being homonymous (according to Art. 31 of the ICPN); it was already used by Oberdorfer [113], by Navarro [114] for the Iberian Peninsula and, as noticed by Di Pietro et al. [43] by Fukarek [115] for the description of riparian communities in Bosnia-Herzegovina. Therefore, the introduction of the *nomen novum* appears necessary in order to introduce a valid name for this syntaxon.

11. ***Geranio nodosi-Alnetum glutinosae*** *ass. nov. hoc loco subass. typicum* (Cluster 11)

Holotypus: Rel. 27, Table 2, *hoc loco*.

Table 2. *Geranio nodosi-Alnetum glutinosae* ass. nov. hoc loco. Appendix A.

Rel. Numbers	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
Rel. Numbers Cluster	310	311	312	313	314	316	324	332	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375
Area (m^2)	150	40	100	100	50	100	100	50	100	200	100	20	150	100	100	50	30	100	50	50	50	50	30	50	80	50	150	100	50	80	80
Aspect	W	W	NE	NW	NW	NE	-	-	-	-	-	-	W	-	-	-	-	-	N	N		-	-	-	W	E	-	-	SE	-	-
Slope (°)	35	25	25	20	15	20	0	0	5	0	0	0	35	0	5	0	5	0	15	15	5	5	5	0	10	20	0	0	10	0	0
Cover (%)	95	90	95	90	85	90	100	90	80	80	50	70	95	95	95	80	95	95	95	95	100	95	100	80	95	95	95	90	90	95	80
Altitude (m s.l.m.)	703	700	862	598	711	843	813	850	839	861	747	709	649	783	739	729	709	521	539	559	639	671	659	629	589	587	689	609	531	533	549
Richness floristic	18	20	18	10	9	19	26	25	35	30	16	11	28	24	18	18	14	24	17	19	16	16	18	12	19	16	33	26	28	18	29
Char. Ass.																															
Geranium nodosum	2	2	1	+	.	2	2	+	1	1	.	2	1	1	2	2	.	r	.	.	+	+	r	.	+	r	2	1	1	+	r
Cardamine heptaphylla	.	.	.	.	.	.	.	r	r	+	+	.	.	+	+	+	.	.	+	.	.	.	.	.	.	.	r	.	.	.	.
Char. Ligustro vulgaris-Alnion glutinosae																															
Circaea lutetiana	1	+	1	.	.	+	2	1	+	+	r	1	+	.	.	r	+	1	2	+	.	.	1	.	+	+	2	2	.	.	+
Aegopodium podagraria	+	r	.	.	.	.	.	.	.	+	.	.	r	+	2	.	.	.	+	.	.	.	r	.	+	.	1	r	r	+	+
Geum urbanum	+	+	.	.	.	.	+	+	.	.	.	.	+	.	.	.	+	+	+	+	.	.	.	.	.	.	1	.	+	+	+
Rubus caesius	2	1	.	.	.	+	.	r	.	.	.	1	.	.	.	.	.	2	3	2	.	.	.	.	.	+	.	.	+	r	+
Sambucus nigra	+	.	.	.	1	2	+	+	.	.	.	2	1	.	.	.	.	+	.	.	.	.	.	.	.	.	1	1	.	.	.
Alliaria petiolata	r	.	.	.	.	1	.	.	.	r	.	.	+	.	.	.	.	1	+	.	+	.	.	.	.	.	.	.	.	.	r
Stachys sylvatica	.	.	2	.	.	r	1	.	r	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardamine impatiens	.	.	.	.	.	.	+	.	+	+	r	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chaerophyllum temulum	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	.	.	.	.	.	.
Char. Alno glutinosae-Populetea albae and Populetalia albae																															
Alnus glutinosa	5	4	4	5	4	4	5	5	4	4	3	3	4	3	3	4	5	4	4	5	5	5	5	4	4	4	4	4	4	5	3
Brachypodium sylvaticum subsp. *sylvaticum*	+	3	.	.	+	.	.	.	1	.	.	1	2	.	.	.	.	1	.	+	2	.	.	.	.	1	r	.	1	1	2
Carex pendula	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	.	1	+	+
Solanum dulcamara	.	.	.	.	.	r	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Carex remota	.	.	.	.	.	.	.	.	2	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix alba	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	2	.	.
Fraxinus angustifolia subsp. *oxycarpa*	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saponaria officinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.
Other species																															
Melica uniflora	+	1	1	1	.	+	1	1	+	1	+	2	+	1	1	.	.	1	+	.	.	+	1	r	r	+	1	+	r	.	1
Hedera helix subsp. *helix*	.	.	.	2	.	.	.	.	.	.	1	2	+	+	.	+	+	.	.	.	.	1	1	r	1	1	1	1	+	+	1
Geranium robertianum	.	+	+	.	.	+	.	3	+	.	+	.	+	.	+	1	.	.	.	.	r	.	r	.	r	r	+	+	+	.	+
Corylus avellana	.	.	.	.	1	.	.	+	.	.	1	.	1	1	1	.	+	.	.	1	2	1	3	1	3	3	1	1	.	.	.

Table 2. *Cont.*

Dryopteris filix-mas	r	.	1	1	1	+	+	.	.	r	.	.	.	.	+	.	+	.	.	1	.	+	.	.	.	.	1	1	.	r	+
Viola reichenbachiana	.	.	+	.	.	.	+	r	.	+	.	.	.	1	.	r	.	.	.	.	.	.	+	r	+	r	r	r	r	.	+
Ranunculus lanuginosus	2	+	.	.	.	.	+	1	1	+	r	.	1	+	.	.	.	.	.	.	r	r	+	+	.	.	.	.	.	.	.
Mycelis muralis	+	.	+	.	.	+	+	1	.	.	.	.	.	.	r	r	.	.	r	.	.	.	.	.	.	r	+	r	r	.	.
Acer pseudoplatanus	+	1	.	.	.	.	.	.	r	+	+	.	2	+	.	+	.	.	.	.	2	.	.	.	.	.	.	1	2	.	.
Clematis vitalba	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	r	r	.	.	.	+	+	r	+	r
Euphorbia dulcis	.	+	.	.	.	.	.	.	r	.	r	.	.	r	r	r	.	+	.	.	.	.	.	.	r	.	r	+	.	.	.
Saxifraga rotundifolia	+	.	+	+	.	.	.	.	r	r	.	.	r	+	r	.	.	.	.	.	.	.	.	.	.	r	.	+	.	.	.
Urtica dioica	.	.	+	.	+	+	.	.	.	+	.	.	.	.	.	1	+	+	.	.	.	.	.	.	.	.	+	.	.	.	+
Fraxinus ornus	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	.	.	.	+	+	.	.	.	.	.	r	.	+	r	+
Equisetum arvense	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	r	+	1	+	.	+	.	.	.	r
Rubus hirtus	.	.	1	.	3	.	.	.	.	.	.	.	+	.	.	.	2	.	.	.	.	.	.	.	.	.	.	+	+	+	+
Acer campestre	.	2	.	.	.	.	.	1	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	1	+	
Lunaria rediviva	.	.	.	.	.	.	.	.	r	.	.	.	.	.	r	+	+	+	1	1	.	.	.	.	.	.	.	.	.	.	.
Cornus sanguinea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	.	2	.	.	.	+	1	+
Chaerophyllum hirsutum (incl. *C. calabrum*)	.	.	.	.	.	2	r	.	2	.	r	.	.	.	.	.	+	.	.	r	.	.	.	.	.	.	.	.	.	.	.
Cardamine bulbifera	.	.	.	.	.	.	.	1	.	.	r	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fagus sylvatica subsp. *sylvatica*	.	.	.	.	.	.	.	.	.	1	.	.	.	3	3	+	.	.	.	.	.	.	.	.	.	.	.	.	1	.	r
Petasites albus	.	.	2	.	1	+	.	.	r	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.
Stellaria nemorum subsp. *montana*	.	.	.	.	.	.	1	.	.	1	1	.	r	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crataegus monogyna	.	1	+	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Castanea sativa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	1	r	.	r	.	.	.	r
Anemonoides nemorosa	.	r	.	.	.	.	.	.	r	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa sylvicola	.	.	.	.	.	.	+	.	+	r	.	.	r	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.
Lolium giganteum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	+	.	.	.	.	.	.	+	.	.	.
Campanula trachelium	.	.	r	+	.	.	.	.	r	.	.	.	r	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxalis acetosella	.	.	.	1	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	.
Polystichum setiferum	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.	+	.	.	.	.	1
Viola alba subsp. *dehnhardtii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	r	r	.
Athyrium filix-femina	.	.	.	.	.	.	1	.	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Equisetum telmateia	.	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.
Carex sylvatica	.	.	.	.	.	.	+	+	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.
Carpinus betulus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	1	.	.	.	.	2
Primula vulgaris	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.	r	.	.

Table 2. *Cont.*

Festuca heterophylla	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Ranunculus repens	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+
Rubus idaeus subsp. *idaeus*	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	1	+	.	.	.
Euphorbia amygdaloides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	+
Helleborus viridis subsp. *bocconei*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	r	.	.	.	.	.	r
Impatiens parviflora	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	r	.	.	+	.	.	.	.	.	.	.	.	.	.
Galeopsis speciosa	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.	r	.	.
Senecio ovatus	.	.	.	.	r	.	+	.	r	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Veronica urticifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	r	.	.	.	r	.	.	.
Lamium galeobdolon	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Mercurialis perennis	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Robinia pseudoacacia	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	+	.	.	.	.	.	.	.	.	1	.	.	.
Poa nemoralis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	+	.	.	.	.	.	+	.	.	.	.
Thalictrum aquilegiifolium subsp. *aquilegiifolium*	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.
Parietaria officinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	+	.	.	.	.	.	.	+	.	.	.	.
Scrophularia nodosa	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	r
Asarum europaeum	.	.	.	2	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dactylis glomerata	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.
Polygonatum multiflorum	.	.	.	.	.	.	.	.	r	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Myosotis sylvatica	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pteridium aquilinum subsp. *aquilinum*	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dioscorea communis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.
Symphytum tuberosum subsp. *angustifolium*	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ficaria verna	.	.	.	.	.	.	.	.	+	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solidago virgaurea	r	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salvia glutinosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	.
Arctium minus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.
Moehringia trinervia	.	.	.	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juglans regia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	2	.	.	.	.
Asplenium trichomanes subsp. *quadrivalens*	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.
Gentiana asclepiadea	.	.	.	.	.	.	.	.	+	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rosa arvensis	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Sedum cepaea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	r	.	.	.	.	.	.	.	.	.	.	.

Table 2. *Cont.*

Rubus ulmifolius	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ficus carica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.
Agrostis stolonifera	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prunella vulgaris subsp. *vulgaris*	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lathyrus venetus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Rumex sanguineus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.
Ajuga reptans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.
Arctium lappa	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ostrya carpinifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.
Dactylorhiza maculata	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rosa sempervirens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lapsana communis	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lonicera etrusca	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prenanthes purpurea	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prunus avium	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clinopodium vulgare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Fragaria vesca subsp. *vesca*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Emerus major	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.
Chelidonium majus	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Daphne laureola	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex conglomeratus	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bromopsis ramosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.
Cardamine chelidonia	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Populus tremula	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pulmonaria hirta	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Impatiens noli-tangere	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.
Adoxa moschatellina subsp. *moschatellina*	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myosotis scorpioides	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Diagnostic species: *Cardamine heptaphylla*, *Euphorbia dulcis*, *Geranium nodosum*, *Lunaria rediviva*, *Stellaria nemorum* subsp. *montana*, *Oxalis acetosella*, *Petasites albus*, *Saxifraga rotundifolia*.

Constant species: *Alnus glutinosa*, *Circaea lutetiana*, *Corylus avellana*, *Geranium robertianum*, *Hedera helix* subsp. *helix*, *Melica uniflora*.

Dominant species: *Alnus glutinosa*.

Structure and ecology: This riparian vegetation is markedly mesophilous and generally present on siliceous substrata in submontane and mountain environments of the Tuscan Apennines, between 500 and 900 m a.s.l., even if sometimes it can be found on alluvial deposits derived from other geological types. Floristically, the herb layer is characterized by several species of mixed mesophilous and beech woods, such as *Geranium nodosum*, *G. robertianum*, *Melica uniflora*, *Circaea lutetiana*, *Cardamine heptaphylla*, and *Geum urbanum*. The tree layer is dominated by *A. glutinosa* with low cover values of other mesophilous wood species, such as *Acer pseudoplatanus*, *Carpinus betulus*, and *Fagus sylvatica*, while the dominated tree and shrubby layer are characterized by *Sambucus nigra* and *Corylus avellana*. According to Pesaresi et al. [79], the area where these communities are distributed is characterized by a temperate oceanic (weakly submediterranean) bioclimate; the thermotype ranges from lower to upper mesotemperate and ombrotypes between upper subhumid and lower humid.

Distribution: Lucca, Pistoia, Prato and Arezzo Apennines (Tuscany).

Landscape context: The association is in catenal contact with mesophilous deciduous mixed oak woods and chestnut woods of the *Quercetalia pubescenti-petraeae*, at higher altitudes also with beech woods of *Fagetalia sylvaticae*.

12. ***Geranio nodosi-Alnetum glutinosae cornetosum sanguineae*** *subass. nov.* (Cluster 12)

Holotypus: Rel. 9, Table 3, *hoc loco*.

Diagnostic species: *Geranium nodosum*, *Pulmonaria hirta*, *Aegopodium podagraria*, *Campanula trachelium*, *Cornus sanguinea*, *Dactylis glomerata*, *Daphne laureola*, *Emerus major*, *Euphorbia dulcis*, *Helleborus viridis* subsp. *bocconei*, *Ostrya carpinifolia*, *Robinia pseudoacacia*.

Constant species: *Acer campestre*, *Alnus glutinosa*, *Brachypodium sylvaticum*, *Carex pendula*, *Circaea lutetiana*, *Clematis vitalba*, *Corylus avellana*, *Fraxinus ornus*, *Hedera helix* subsp. *helix*, *Melica uniflora*, *Mycelis muralis*, *Sambucus nigra*.

Dominant species: *Alnus glutinosa*.

Structure and ecology: This riparian vegetation is very close to the previous communities of Cluster 11, and also occurring on similar geological substrates. Clusters 11 and 12 also share several diagnostic and constant species (*Geranium nodosum*, *Circaea lutetiana*, *Euphorbia dulcis*, *Melica uniflora*, etc.), but the relevés of Cluster 12 are less markedly mesophilous, because they are generally present at lower altitudes, between 150 and 600 m a.s.l. Floristically, the herbaceous layer has lost many species of beech woods, which have been replaced by lower-altitude entities (e.g., *Saxifraga rotundifolia* is non more present, while *Petasites albus* has been replaced by *Petasites hybridus*). The tree layer is dominated by *Alnus glutinosa* with low cover values of other wood species, such as *Acer campestre* and *Ostrya carpinifolia*, sometimes also with the invasive *Robinia pseudacacia*. The dominated tree and shrub layers are characterized by *Sambucus nigra* and *Corylus avellana*, as in Cluster 11. For all the above-mentioned reasons, we propose treating the relevés of Cluster 12 as a subassociation of the *Geranio nodosi-Alnetum glutinosae*, named *cornetosum sanguineae*.

Distribution: Tuscany. Lucca, Pistoia, Prato, Siena and Arezzo Apennines.

Landscape context: The subassociation is in catenal contact with mesophilous and thermophilous deciduous mixed oak woods and chestnut woods of the *Quercetalia pubescenti-petraeae*.

13. ***Hyperico hircini-Alnetum glutinosae*** Gafta and Pedrotti 1996 (Cluster 13)

Syn.: *Circaeo lutetianae-Alnetum glutinosae* (Blasi and Frondoni 1996)

Holotypus: Rel. 1, [55] (pp. 414–415)

Diagnostic species: *Amorpha fruticosa*, *Bidens frondosa*, *Carex riparia*, *Limniris pseudacorus*, *Lythrum salicaria*, *Salix alba*, *Tommasinia altissima*.

Table 3. *Geranio nodosi-Alnetum glutinosae cornetosum sanguineae* subass. nov. hoc loco. Appendix A.

Rel. Numbers	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
Rel. Numbers Cluster	315	317	318	319	320	321	322	323	325	326	327	328	329	330	331	333	334	335	337	339	340	343	344	345	346	347	348	349
Area (m2)	100	50	50	50	30	100	50	50	20	50	45	80	100	50	100	50	50	300	100	70	70	200	80	60	200	100	100	100
Aspect	W	W	NE	N	E	-	-	-	E	SE	SE	-	-	-	-	-	-	N	-	-	NE	-	-	-	NW	-	-	-
Slope (°)	20	5	25	3	30	0	0	0	5	10	45	0	0	0	0	0	0	6	0	0	30	32	3	3	6	2	2	2
Cover total (%)	100	95	90	85	90	95	85	100	100	100	90	90	90	90	90	90	100	100	85	100	95	100	95	90	100	100	90	100
Altitude (m s.l.m.)	240	265	145	283	287	631	173	286	263	263	235	540	540	600	560	740	550	620	330	251	265	520	440	445	630	320	340	380
Richness floristic	25	23	28	25	25	22	25	16	21	30	39	31	32	34	33	29	32	25	23	36	31	32	31	30	46	39	37	28
Char. Ass.																												
Geranium nodosum	.	1	+	+	+	.	+	1	1	2	+	1	+	1	1	2	1	.	r	+	1	2	1	1	2	.	+	+
Cornus sanguinea	1	.	1	.	.	.	.	1	2	1	+	1	+	+	1	.	2	.	3	1	+	+	1	1	.	+	1	1
Char. Ligustro vulgaris-Alnion glutinosae																												
Aegopodium podagraria	.	.	.	.	1	.	+	.	3	3	2	+	+	2	3	3	2	.	2	.	3	.	2	1	+	1	.	1
Circaea lutetiana	1	.	+	.	+	1	+	1	1	2	+	1	+	.	1	+	.	1	.	.	.	1	.	.	1	.	+	.
Rubus caesius	.	.	1	.	.	.	.	.	.	1	.	3	1	1	1	.	.	.	2	.	.	2	1	.	.	+	+	2
Geum urbanum	.	+	.	.	+	+	.	.	.	+	+	.	.	.	+	.	.	+	.	+	.	.	.	.	+	.	+	.
Petasites hybridus subsp. *hybridus*	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	r	.	1	2	+	1	+	2
Alliaria petiolata	.	.	.	.	.	+	.	.	.	+	.	.	.	.	2	.	+	.	.	+	r	+	.	.	.	.	+	.
Stachys sylvatica	.	.	.	+	.	+	.	.	.	.	.	1	.	1	.	+	.	.	.	.	.	+	.	.	1	.	.	.
Cardamine impatiens	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1	.	.	.	.	.	.	2	.	.	.
Chaerophyllum temulum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	+	+	.
Char. Alno glutinosae-Populetea albae and Populetalia albae																												
Alnus glutinosa	4	4	5	5	4	4	5	4	4	4	4	4	5	4	5	5	5	5	5	3	5	5	5	5	4	4	4	4
Brachypodium sylvaticum subsp. *sylvaticum*	+	.	+	.	.	.	+	.	.	.	2	+	+	2	1	.	2	+	1	.	+	+	1	1	.	1	+	+
Carex pendula	1	.	1	+	+	.	+	1	.	.	+	.	+	+	1	+	+	.	.	.	.	.	1	1	1	2	+	.
Sambucus nigra	1	1	1	1	.	1	2	+	.	2	.	.	.	.	1	.	.	.	r	1	+	1	.	.	.	+	1	.
Solanum dulcamara	R	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex remota	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Salix alba	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	1	.	.
Populus nigra	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	2
Fraxinus angustifolia subsp. *oxycarpa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Saponaria officinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.
Other species																												
Hedera helix subsp. *helix*	3	2	2	2	2	+	1	3	1	2	1	.	.	+	+	.	2	+	3	2	1	+	1	3	1	2	3	+

Table 3. *Cont.*

Clematis vitalba	1	+	1	1	1	1	+	+	1	1	.	+	1	.	.	.	1	1	1	+	.	1	1	1	+	+	+	1
Melica uniflora	+	+	+	+	.	+	+	+	1	1	+	+	+	.	+	1	.	.	.	r	.	+	.	.	2	+	1	1
Corylus avellana	1	1	.	1	2	.	.	1	+	.	1	+	+	+	.	.	.	.	r	r	1	1	1	.	2	1	2	1
Acer campestre	.	+	+	.	+	.	.	.	+	.	+	r	+	1	+	+	+	.	3	1	2	.	.	+	.	+	1	+
Fraxinus ornus	.	1	.	1	+	+	+	.	.	.	.	+	.	1	.	+	1	.	1	1	+	+	2	1	.	+	.	.
Mycelis muralis	.	.	+	+	+	+	.	.	.	.	.	+	+	.	+	+	.	.	+	r	+	+	.	.	+	+	+	1
Rubus ulmifolius	1	+	1	1	1	2	1	.	.	.	+	.	.	2	.	.	.	2	.	+	+	.	.	+	1	.	.	.
Dioscorea communis	+	+	+	+	+	.	.	.	+	+	2	.	+	.	.	.	.	+	.	2	.	.	+	.	.	.	+	.
Polystichum setiferum	2	1	1	.	+	+	+	1	1	1	2	.	.	.	.	.	.	.	.	.	.	2	.	.	+	.	+	.
Crataegus monogyna	.	.	1	1	.	.	.	.	.	.	+	+	+	2	1	.	+	+	+	.	+	.	+	.	+	.	.	.
Geranium robertianum	.	.	.	+	.	1	.	.	.	.	.	1	+	.	.	.	.	1	r	+	.	1	.	.	2	+	+	+
Primula vulgaris	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	1	+	.	.	+	+	.	+	1	.	+	+	+
Viola reichenbachiana	.	+	1	.	.	.	.	.	.	.	1	.	+	r	.	1	.	.	+	.	.	.	.	1	.	+	+	+
Euphorbia dulcis	.	+	.	.	.	.	.	.	.	.	.	+	+	r	+	+	+	.	.	.	.	+	+	.	+	.	.	.
Ostrya carpinifolia	.	.	.	1	.	.	.	.	.	.	1	2	.	.	.	1	1	1	.	.	2	+	.	1	+	.	.	.
Urtica dioica	+	.	.	.	.	+	+	.	.	1	.	1	.	.	+	.	.	2	.	+	+	.	.	.	1	.	.	.
Symphytum tuberosum subsp. *angustifolium*	1	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	.	+	.	.	+	.	.	+	+	+	+
Campanula trachelium	.	.	.	+	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	+	+	+
Robinia pseudoacacia	.	.	.	.	.	.	+	.	.	.	1	1	.	.	.	.	+	.	r	2	.	1	2	.	.	.	2	.
Ranunculus lanuginosus	+	.	+	.	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	+	.	.	.	1	1	+
Eupatorium cannabinum	.	.	+	.	.	.	+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	1	1	.	+	.	.
Euonymus europaeus	.	+	.	+	+	.	.	2	.	+	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.
Dryopteris filix-mas	+	.	.	+	+	+	.	.	.	.	+	.	.	.	.	.	.	.	r	1	.	.	.	.	+	.	+	.
Lamium galeobdolon subsp. *flavidum*	1	1	1	.	1	.	+	+	.	.	.	.	.	+	2	.	.	.	+	.	.	.	.	.	.	.	.	.
Prunus avium	.	.	.	.	.	.	.	.	.	+	.	+	+	1	.	1	+	.	.	.	.	.	.	+	+	.	.	.
Emerus major	.	+	.	+	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	+	.	+	.	.	.	.
Galium aparine	.	.	.	.	.	.	.	.	.	+	1	.	.	+	+	.	.	+	.	.	.	.	.	.	+	+	.	.
Sanicula europaea	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	2	+	.	.	.	.	.	+	.	.	+	+	+
Acer pseudoplatanus	.	.	.	.	.	+	.	.	.	2	.	.	+	+	r	+	+	.	.	.	.	.	.	.	.	.	.	.
Solidago virgaurea	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	+	.	r	.	.	+	.	+	.	.	+	.
Viola riviniana	+	.	.	+	+	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Tussilago farfara	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	1	1	.	2	1	+
Pulmonaria hirta	.	.	.	.	.	.	.	.	1	+	+	.	.	.	.	+	.	.	.	.	.	.	+	.	+	.	.	.
Daphne laureola	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	.	+	.	.	r	.	.	.	.	.	.	.	+
Helleborus viridis subsp. *bocconei*	.	.	.	.	.	.	.	.	1	.	.	.	.	.	+	+	+	.	r	.	+	.	.	.	.	.	.	.

Table 3. *Cont.*

Viola alba subsp. *dehnhardtii*	.	.	.	.	.	.	.	.	1	+	.	.	.	.	1	1	1	.	.	r	.	.	.	.	.	.	.	.
Equisetum arvense	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	r	.	+	.	.	+	.	.
Arum italicum	+	.	.	.	.	.	.	.	+	.	.	.	.	1	+	+	.	.	.	r	.	.	.	.	.	.	.	.
Carex sylvatica	.	.	.	.	.	.	.	.	.	1	r	.	.	.	.	+	.	.	.	.	.	1	1	.	+	.	.	.
Carpinus betulus	.	2	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	1	.	.	.	.	.	+	+	.
Castanea sativa	.	.	.	.	.	2	.	.	.	.	+	.	.	.	.	.	.	1	.	r	2	.	.	.	1	.	.	.
Arctium lappa	+	.	.	.	.	r	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	r	.	.	.	.	.	.
Dactylis glomerata	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	+	.	+	.	+	.	.
Athyrium filix-femina	1	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.
Salvia glutinosa	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	+	.	.	2	.	.	.
Cornus mas	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	+	1	.
Lonicera etrusca	.	+	+	.	+	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.
Rubia peregrina	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Festuca heterophylla	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.	+	.	.	+	.	.	.
Chaerophyllum hirsutum (incl. *C. calabrum*)	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Rosa canina	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Cardamine bulbifera	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	+	.	.	.	2	.	+	.
Rosa arvensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+
Ruscus aculeatus	.	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mentha aquatica	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Ulmus minor	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Rubus hirtus	.	.	.	.	.	.	1	2	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Ficaria verna	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.
Ligustrum vulgare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	+
Hypericum androsaemum	+	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anemonoides nemorosa	.	.	.	+	.	.	.	.	r	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prunus spinosa subsp. *spinosa*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	+	.	.	.
Galium album	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.
Lolium giganteum	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryonia dioica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.
Moehringia trinervia	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	1	.	r	.	.	.	.	.	.	.	.
Laurus nobilis	.	1	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla micrantha	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Quercus cerris	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.

Table 3. *Cont.*

Asplenium trichomanes subsp. *quadrivalens*	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	r	.	.	.	.	.	.	.	.
Pteridium aquilinum subsp. *aquilinum*	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Equisetum telmateia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.
Ranunculus repens	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.
Poa sylvicola	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scrophularia nodosa	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.
Brachypodium rupestre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	2	.	.	.	.	.
Asplenium scolopendrium subsp. *scolopendrium*	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Fragaria vesca subsp. *vesca*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	.	.	.	.	.	.	.
Geranium purpureum	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Heracleum sibiricum subsp. *ternatum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	r	.	.	.	.	.	.	.	.
Impatiens parviflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.
Cardamine pratensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	.	.	.
Senecio ovatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.
Cardamine heptaphylla	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga rotundifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.
Ficus carica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Cyclamen repandum subsp. *repandum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Rumex sanguineus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stellaria media subsp. *media*	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lonicera caprifolium	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa trivialis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Arisarum proboscideum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Mercurialis perennis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Agrostis stolonifera	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Fagus sylvatica subsp. *sylvatica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.
Euphorbia amygdaloides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Poa nemoralis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Juglans regia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.

Table 3. *Cont.*

Physospermum cornubiense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Parietaria officinalis	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cyclamen hederifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Cruciata glabra	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acer opalus subsp. *obtusatum*	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bromopsis ramosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Rumex conglomeratus	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ailanthus altissima	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.
Chelidonium majus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.
Selaginella denticulata	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arisarum vulgare subsp. *vulgare*	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardamine chelidonia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.
Plantago major	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Pulicaria dysenterica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Sedum cepaea	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Veronica urticifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.
Adoxa moschatellina subsp. *moschatellina*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.

Constant species: *Alnus glutinosa*, *Brachypodium sylvaticum*, *Carex pendula*, *Clematis vitalba*, *Eupatorium cannabinum*, *Hedera helix* subsp. *helix*, *Rubus ulmifolius*.

Dominant species: *Alnus glutinosa*, *Brachypodium sylvaticum*.

Characteristic species (according to the literature): *Hypericum hircinum* subsp. *majus*

Structure and ecology: Riparian thermophylous wood vegetation dominated by *A. glutinosa*, associated with *Salix alba* and *S. pedicellata* [55]. The shrubby and lianose layer is well represented with *Ficus carica*, *Ulmus minor*, *Sambucus nigra*, *Hedera helix*, *Clematis vitalba*, *Vitis vinifera* subsp. *sylvestris*, *Solanum dulcamara*. Some nemoral and hygrophilous species make up the herbaceous layer, including *Carex pendula*, *C. remota*, *Rumex sanguineus*, *Arum italicum*. These vegetation woods grow along perennial waterways that flow in the coastal plains or in wide, slightly sloping valleys of the hilly belt, from sea level up to about 600 m. They are widespread in areas characterized by Mediterranean pluseasonal oceanic bioclimate, thermo-Mediterranean thermotype and subhumid–humid ombrotype.

Distribution: Calabria, Latium, Abruzzo, Umbria, Tuscany, Emilia Romagna.

Landscape context: This riparian wood potentially makes catenal contact with *Quercus virgiliana*, thermophilous oak woods of the *Quercetea ilicis* class, or with the secondary communities, such as scrub vegetation of *Rhamno-Prunetea*.

Notes: the type described by Gafta and Pedrotti [55] for Calabria is grouped with the plant communities of Tuscany and Latium, previously indicated as *Circaeo lutetianae-Alnetum glutinosae*.

14. *Lamio orvalae-Alnetum glutinosae* Dakskobler 2016 (Cluster 14)

Holotypus: Rel. 9, Tab.8 [116].

Diagnostic species: *Filipendula ulmaria*, *Fraxinus excelsior* subsp. *excelsior*, *Lamium galeobdolon* subsp. *flavidum*, *Lamium orvala*, *Potentilla indica*, *Quercus robur*, *Rubus caesius*, *Valeriana dioica*, *Virburnum opulus*, *Frangula alnus* subsp. *alnus*, *Glechoma hederacea*, *Ligustrum vulgare*, *Polygonatum multiflorum*, *Prunus avium*.

Constant species: *Alnus glutinosa*, *Carex pendula*, *Carex remota*, *Cornus sanguinea*, *Corylus avellana*, *Geum urbanum*, *Hedera helix* subsp. *helix*, *Sambucus nigra*.

Dominant species: *Alnus glutinosa*.

Characteristic species (according to the literature): *Lamium orvala*, *Primula vulgaris*, *Cerastium sylvaticum*, *Galanthus nivalis*, *Loncomelos pyrenaicus* [66]; *Alnus glutinosa*, *Lamium orvala*, *Ornithogalum pyrenaicum and Galanthus nivalis*, *Scilla bifolia*, *Allium ursinum*, *Cardamine bulbifera*, *Crocus vernus* subsp. *vernus* [116].

Structure and ecology: Riparian woods occurring along the small rivers of the hilly and lowland belt of north-eastern Italy. This vegetation grows on medium-evolved and brownified, neutral-alkaline, clayey or fluvisol soils, often on mixed mother rock, flysch, marl and carbonates. The tree layer is characterized by *A. glutinosa*, *Acer campestre*, *Prunus avium*, *Quercus robur*, *Salix alba*, *Populus nigra*, while very rare are *Carpinus betulus*, *Acer pseudoplatanus*, *Ulmus minor*. The shrub layer is mainly characterized by *Rubus caesius*, together with *Cornus sanguinea*, *Corylus avellana*, *Viburnum opulus*, *Ligustrum vulgare*, *Sambucus nigra*, *Crataegus monogyna*, etc. The herbaceous layer consists of large tufts of *Carex pendula* and *Carex remota*, together with *Geum urbanum*, *Athyrium filix-femina*, *Lamium galeobdolon* subsp. *flavidum*, *Primula vulgaris*, *Dryopteris filix-mas*.

Distribution: north-eastern Italy (Friuli Venezia Giulia, Veneto, Lombardy).

Landscape context: The association is in catenal contact with *Lamio orvalae-Ulmetum* and with neutral acidophilous oak forests of medium and high slopes (*Carici umbrosae-Quercetum petraeae*, *Seslerio autumnalis-Quercetum pubescentis*). In the lower plain, the contacts are with the hygrophilous hedges (*Frangulo-Viburnetum opuli*) and with herbaceous cenoses representing secondary stages of the plain wood (*Asparago-Quercetum roboris*), such as *Poo-Lolietum multiflori* and *Plantagini-Molinietum caeruleae* [66].

Notes: *Lamio orvalae-Alnetum glutinosae*, described by Dakskobler [116] for south-western Slovenia, is classified in the *Fagetalia sylvaticae*. Subsequently, *Lamio orvalae-Alnetum glutinosae* is reported by Poldini and Sburlino [66] for the first time in north-eastern Italy. According to Poldini and Sburlino [66], due to its azonality character, *Lamio-Alnetum*

glutinosae is to be included in the *Alnion incanae* alliance and *Alno-Fraxinetalia excelsioris* order (*Alno-Populetea*), the latter order grouping the azonal riparian communities of central Europe. Our results include *Lamio orvalae-Alnetum glutinosae* in the *Ligustro vulgaris-Alnion glutinosae* alliance, where the association finds a chorological correspondence with the diagnosis of the alliance described by Poldini et al. [16] for northern and central Italy. In our opinion, this vegetation should be studied more in depth, in order to correctly classify it.

15. ***Polysticho setiferi-Alnetum glutinosae*** Brullo, Scelsi, Spampinato 2001 (Cluster 15, Figure 7)

Holotypus: Rel. 1, Tab. 29 [61].

Diagnostic species: *Dactylorhiza maculata* subsp. *saccifera*, *Geranium versicolor*, *Poa trivialis*, *Rubus canescens*, *Stachys sylvatica*, *Arctium minus*, *Athyrium filix-femina*.

Constant species: *Alnus glutinosa*, *Brachypodium sylvaticum* subsp. *sylvaticum*, *Carex remota*, *Geranium robertianum*, *Lamium flexuosum*, *Mycelis muralis*, *Sambucus nigra*, *Urtica dioica*.

Dominant species: *Alnus glutinosa*.

Characteristic species (according to the literature): *Polystichum setiferum*.

Structure and ecology: Riparian woods with a clear dominance of *Alnus glutinosa*. The shrub layer is poorly represented with *Ilex aquifolium*, *Sambucus nigra* and *Salix caprea*. Various hygrophilous and calcifugous ferns live in the herbaceous layer, among which in particular *Polystichum setiferum*, *Dryopteris affinis*, *Athyrium filix-femina*, which make the association different. This plant community grows along watercourses that flow in narrow valleys and ravines of the mountain and submontane belt, between 500 and 1100, characterized by a wetter and cooler mesoclimate than the surrounding macroclimatic conditions that fall within the meso or supra-Mediterranean humid or hyperhumid bioclimatic belt. It occurs in the Mediterranean-mountain areas geologically characterized by metamorphic rock or granites.

Distribution: Serre Calabre, Sila, North and Western slope of Aspromonte (Calabria) [117,118], Cilento (Campania).

Landscape context: This wood normally makes catenal contact with mixed mesothermophilous deciduous forests growing on the slopes of the valleys, and referrable to the *Tilio-Ostryon carpinifoliae* Brullo, Scelsi and Spampinato 2001 or *Pino-Quercion congestae* Brullo Scelsi, Siracusa and Spampinato 1999, both alliance endemic of southern Italy [119].

Notes: Based on our analysis, the Campania findings attributed by Rosati et al. [58] to *Euphorbio corallioides-Alnetum glutinosae* are also to be included in the *Polysticho setiferi-Alnetum glutinosae*.

16. ***Euphorbio corallioides-Alnetum glutinosae*** Brullo and Furnari in Barbagallo et al. 1982 (Cluster 16, Figure 7)

Holotypus: Rel. 1, Tab. 1 [59].

Diagnostic species: *Ajuga reptans*, *Aquilegia vulgaris*, *Arctium lappa*, *Arisarum proboscideum*, *Chaerophyllum hirsutum* (incl. *C. calabrum*), *Cirsium creticum* subsp. *triumfettii*, *Clinopodium vulgare*, *Crepis leontodontoides*, *Cruciata laevipes*, *Dactylorhiza maculata*, *Dryopteris filix-mas*, *Euphorbia corallioides*, *Euphorbia meuselii*, *Geranium lucidum*, *Geranium versicolor*, *Holcus mollis*, *Hypericum perforatum*, *Impatiens noli-tangere*, *Lamium galeobdolon* subsp. *montanum*, *Lapsana communis*, *Lysimachia nummularia*, *Mentha longifolia*, *Poa nemoralis*, *Prunella vulgaris* subsp. *vulgaris*, *Rubus idaeus* subsp. *idaeus*, *Rumex acetosa*, *Rumex sanguineus*, *Scrophularia scopolii*, *Solanum dulcamara*, *Stachys sylvatica*, *Thalictrum aquilegiifolium* subsp. *aquilegiifoli*, *Thalictrum lucidum*, *Thalictrum simplex* subsp. *simplex*, *Trifolium repens*, *Veronica montana*, *Fagus sylvatica* subsp. *sylvatica*, *Galium aparine*, *Lamium flexuosum*, *Polygonatum multiflorum*, *Pteridium aquilinum* subsp. *aquilinum*, *Symphytum tuberosum* subsp. *angustifolium*.

Constant species: *Alnus glutinosa*, *Brachypodium sylvaticum*, *Carex pendula*, *Carex remota*, *Sambucus nigra*, *Urtica dioica*.

Dominant species: *Alnus glutinosa*.

Characteristic species (according to the literature): *Arisarum proboscideum*, *Aquilegia vulgaris*, *Euphorbia corallioides*, *Thalictrum simplex* subsp. *simplex*.

Structure and ecology: Riparian wood with a canopy dominated by *A. glutinosa* accompanied to few other tree species as *Populus nigra*. A rich contingent of hygrophilous nemoral species make up the herbaceous layer, such as *Athyrium filix-femina*, *Carex remota*, *Chaerophyllum hirsutum* (incl. *C. calabrum*), *Thalictrum aquilegiifolium* and some endemic or subendemic species from southern Italy, such as *Euphorbia corallioides*, *Arisarum proboscideum*.

The association occurs along the rivers of the mountain belt, between 900 and 1300, generally on flat or slightly steep alluvial soils of a siliceous nature originating from metamorphytes or from granites and granodiorites, in areas with an oceanic temperate bioclimate with thermotype between upper mesotemperate and lower supratemperate, and upper subhumid ombrotype.

Distribution: Mountain range of Calabria. Described for the Serre Calabre plateau [59], it is also widespread on the Sila plateau [60] while it becomes rarer in Aspromonte [61,118].

Landscape context: These alder woods occur along rivers that flow in areas potentially occupied by beech forests of the *Geranio versicoloris-Fagion sylvaticae* Gentile 1970 but, rather than with beech woods they make contacts with secondary formations of the dynamic series, such as acidophilous shrublands of the class *Cytisetea scopario-striati* Rivas-Martínez 1975 or *Pteridium aquilinum* stands, as on the Sila and Serre Calabre highlands cultivated in the past and then abandoned and used as pasture.

Notes: The localization of this community in the oceanic temperate bioclimate affects the rich contingent of *Querco-Fagetea* nemoral species, such as *Brachypodium sylvaticum*, *Geranium versicolor*, *Poa nemoralis*, and *Euphorbia meuselii*. In Sila highlands, alder woods form a gallery forest that closes above the river, favouring a constant shadow thanks to which can be established very rare hygrophilous nemoral sciaphilous plant communities in direct contact with water that hosts species of great phytogeographical interest, such as *Rhynchocorys elephas*, *Chrysosplenium dubium* and the endemic *Cryptotaenia thomasii*.

17. *Asperulo taurinae-Alnetum glutinosae* *ass. nov. hoc loco* (Cluster 17)

Syn.: *Euphorbio corallioides-Alnetum glutinosae sensu* Rosati et al. (2005) non Brullo and Furnari in Barbagallo et al. 1982

Holotypus: Rel. 11, Tab. 8 [58].

Diagnostic species: *Alnus cordata*, *Anemone apennina*, *Aremonia agrimonoides* subsp. *agrimonoides*, *Arisarum proboscideum*, *Asperula taurina* subsp. *taurina*, *Geranium versicolor*, *Juglans regia*, *Lamium flexuosum*, *Lysimachia nummularia*, *Rubus hirtus*, *Salvia glutinosa*, *Symphytum bulbosum*, *Circaea lutetiana*, *Lamium galeobdolon* subsp. *montanum*, *Melica uniflora*, *Polystichum setiferum*, *Ranunculus lanuginosus*, *Sanicula europaea*, *Scutellaria columnae* subsp. *gussonei*, *Vinca major*.

Constant species: *Alnus glutinosa*, *Arum italicum*, *Athyrium filix-femina*, *Brachypodium sylvaticum* subsp. *sylvaticum*, *Carex pendula*, *Clematis vitalba*, *Dioscorea communis*, *Geranium robertianum*, *Mycelis muralis*, *Rubus ulmifolius*, *Viola reichenbachiana*.

Dominant species: *Alnus glutinosa*.

Structure and ecology: Riparian woods growing along the high course of the streams engraved in the slopes of the arenaceous-conglomerate reliefs of Mt. Sacro, between 500 and 1200 m a.s.l.; the area is characterized by mesotemperate to the lower supratemperate bioclimate, humid to sub-humid level. Occasionally, in particular geomorphological areas, it is possible to find these woods even at much lower altitudes (250 m a.s.l.). The tree layer, dominated by *A. glutinosa*, covers between 60 and 90%. The shrub layer, with average cover of about 60%, consists of *Rubus hirtus*, *R. ulmifolius*, *Sambucus nigra*, *Clematis vitalba*, *Hedera helix*, *Dioscorea communis*. The herbaceous layer is rich in hygrophilous species, such as *Carex pendula*, *C. remota*, *Circea lutetiana*, *Lysimachia nemorum*; also several mesophilous species are frequent, such as *Stachys sylvatica*, *Salvia glutinosa*, *Scrophularia scopolii*, *Arisarum proboscideum*, *Asperula taurina*, *Geranium versicolor*, *Lamium flexuosum*, *Melica uniflora*, *Ranunculus lanuginosus*, *Sanicula europaea*. Numerous nitrophilous species also occur: *Urtica dioica*, *Galium aparine*, *Arum italicum*, *Ranunculus repens*. Some ferns find in these environments their optimum: *Athyrium filix-femina*, *Dryopteris filix-mas* and *Polysticum setiferum*. The communities observed in the Cilento area show a strong ecological, coenolog-

ical and biogeographic affinity with the association *Euphorbio corallioides-Alnetum glutinosae* described for the Serre Calabre [59]. Nevertheless, most of the species reported as characteristics of the association (*Euphorbia corallioides*, *Chaerophyllum hirsutum* var. *calabricum*, *Arisarum proboscideum*, *Thalictrum morisonii* subsp. *mediterraneum*, *Thalictrum simplex* subsp. *simplex*, *Aquilegia vulgaris*) have a local significance; thus, the *Euphorbio corallioides-Alnetum glutinosae* has to be considered as limited to different parts of the Calabria region (Serre, Aspromonte, Sila) at elevation between 900 and 1300 m a.s.l., within the climatic belt of *Geranio versicoloris-Fagion* [60]. Among the characteristic species of *Euphorbio corallioides-Alnetum glutinosae*, only *Arisarum proboscideum* and *Aquilegia vulgaris* are present in the communities analyzed in the Cilento. For this reason, we propose a new association with the name *Asperulo taurinae-Alnetum glutinosae*. From the syntaxonomic point of view, the association is to be referred to the *Alnion incanae* for the presence and abundance in these communities of a large contingent, such as *Stachys sylvatica*, *Circaea lutetiana*, *Carex remota*, *Carex pendula*, *Symphytum tuberosum*, and *Rumex sanguineus*.

Distribution: Cilento, Campania [58].

Landscape context: This riparian wood potentially makes catenal contact with beech forests of the *Geranio versicoloris-Fagion sylvaticae* Gentile 1970. In altered environments, they make contacts with secondary formations, such as acidophilous shrublands of the class *Cytisetea scopario-striati* Rivas-Martínez 1975.

Notes: Gafta and Pedrotti [55] on the basis of the presence of some differential species (*Arisarum proboscideum*, *Hypericum hircinum*, *Geranium versicolor*) refer the *Euphorbio-Alnetum glutinosae* to the *Hyperico androsaemi-Alnenion glutinosae*.

18. *Angelico sylvestris-Alnetum glutinosae* Brullo and Spampinato 1997 (Cluster 18, Figure 7)

Holotypus: Rel. 12, Tab. 2 [60].

Diagnostic species: *Angelica sylvestris* subsp. *sylvestris*, *Convolvulus silvaticus*, *Ranunculus neapolitanus*, *Rumex sanguineus*, *Salix alba*, *Salix brutia*, *Solanum dulcamara*, *Valerianella locusta*, *Veronica scutellata*, *Vinca minor*, *Viola alba* subsp. *dehnhardtii*, *Chaerophyllum temulum*, *Clematis viticella*, *Helosciadium nodiflorum*, *Poa trivialis*, *Populus alba*.

Constant species: *Alnus glutinosa*, *Arum italicum*, *Brachypodium sylvaticum*, *Carex pendula*, *Clematis vitalba*, *Hedera helix* subsp. *helix*, *Rubus ulmifolius*, *Sambucus nigra*, *Stachys sylvatica*, *Urtica dioica*.

Dominant species: *Alnus glutinosa*, *Angelica sylvestris*, *Salix alba*.

Characteristic species (according to the literature): *Angelica sylvestris*.

Structure and ecology: Riparian woods dominated by *A. glutinosa* associated with other hygrophilous trees, such as *Populus alba*, *P. nigra* and *Salix alba*. The shrubby and lianose layer is well represented with *Sambucus nigra*, *Cornus sanguinea*, *Hedera helix*, *Clematis vitalba*, *Solanum dulcamara*. A rich group of nemoral and hygrophilous species makes up the herbaceous layer, including *Angelica sylvestris*, *Carex pendula*, *C. remota*, *Rumex sanguineus*, and *Stachys sylvatica*. These alder woods grow along perennial waterways that flow in the coastal plains or in wide, slightly sloping valleys of the hilly belt, from sea level up to about 600 m. They are widespread in areas characterized by Mediterranean pluseasonal oceanic bioclimate, thermo or meso-Mediterranean thermotype and subhumid–humid ombrotype. The alluvial soils are loamy or sandy, rich in organic matter, normally flooded during the winter with high edaphic humidity even in summer. The high presence of *Urtica dioica*, *Chaerophyllum temulum* and *Stachys sylvatica* reveals a substrate rich in nutrients.

Distribution: Central-northern Calabria [117].

Landscape context: This riparian woods potentially make catenal contact with *Quercus virgiliana*, thermophilous oak woods of the *Quercetea ilicis* class, or with the secondary formations of the dynamic series, such as scrub communities located on non-alluvial soils outside the river floodplain. More frequently, they are flanked by cultivated or uncultivated lands.

In relation to variations in river dynamics, this association constitutes a gallery wood in direct contact with the lower bed of the watercourse or is separated from it by a band of

shrub willows of the *Salicetea purpureae* class. In this case, species such as *Salix purpurea* subsp. *lambertiana*, *S. brutia* can be found in the shrub layer.

Notes: In the lowland areas with a more prolonged period of flooding, such as at the mouths of the main rivers, occurs the particular subassociation of the *Angelico sylvestris-Alnetum glutinosae iridetosum pseudacori*, differentiated by *Clematis rigoi* (endemic of southern Italy) and *Limniris pseudacorus*, both species linked to loamy soils with high groundwater. This subassociation makes catenal contact with *Populus alba* lowland woods of the *Clematido viticellae-Populetum albae* [60,120].

4. Conclusions

The present paper provides a comprehensive and exhaustive framework of the *A. glutinosa* riparian woodlands diversity in the central Mediterranean area. Overall, a total of 18 *A. glutinosa*-riparian wood communities were distinguished for Italy and Tyrrhenian islands, of which two new associations and one new subassassociation are described within the *Ligustro vulgaris-Alnion glutinosae* (*Geranio nodosi-Alnetum glutinosae*, *Geranio nodosi-Alnetum glutinosae cornetosum sanguineae*, *Asperulo taurinae-Alnetum glutinosae*). The alder forests in Italy and Corsica are classified into the *Populetalia albae* order (*Alno glutinosae-Populetea albae* class). This order, with Mediterranean gravitation, includes two alliances. The first, *Osmundo-Alnion*, with west-Mediterranean and Tyrrhenian Italy distribution, is split into two different geographical groups: *Hyperico hircine-Alnenion glutinosae* that includes the thermophilous communities with a circumtyrrhenian distribution (Sardinia, Corsica, north-aestern Sicily, Tyrrhenian coasts of the Italian peninsula) and *Struthioptero-Alnenion glutinosae* suballiance, that includes the thermo-mesophilous plant communities of central Italy, up to the Sardinian and Corsican mountains. The second alliance, *Ligustro vulgaris-Alnion glutinosae*, includes the riparian meso-thermophilous communities of the northern and central and southern peninsula. This last alliance shows two geographic variants at the national level, which should be better investigated: the first includes the more mesophilous communities with the northern Italy distribution, while the second includes the southernmost mesophilous communities.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/land12010088/s1, Table S1: Synoptic table of the associations and alliances of riparian forests of the Italian Peninsula and Corsica.

Author Contributions: Conceptualization, S.S.; methodology, S.S. and V.T.; investigation, S.S., C.A., G.B., M.C., J.D., M.F., A.G., M.G., L.G., M.L., P.M., C.P., M.P., G.S., G.T., V.T., D.V. and G.G.d.G.; data curation, S.S.; writing—original draft preparation, S.S., C.A., G.B., M.C., J.D., M.F., A.G., M.G., L.G., M.L., P.M., C.P., M.P., G.S., G.T., V.T., D.V. and G.G.d.G.; writing—review and editing, S.S., C.A., G.B., M.C., J.D., M.F., A.G., M.G., L.G., M.L., P.M., C.P., M.P., G.S., G.T., V.T., D.V. and G.G.d.G. All authors have read and agreed to the published version of the manuscript.

Funding: This research was financially supported by the research programme (PIA.CE.RI. 2020–2022 Line 2 cod. 22722132149 and Line 3 Starting Grant Progetto HAB-VEG cod. 22722132172) funded by the University of Catania.

Acknowledgments: The authors would like to acknowledge the Reviewers for their valuable comments that significantly improved the quality and clarity of the manuscript and for proofreading the manuscript.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Localities of Relevés

Table 1. Rel. 1–5, da Brullo and Spampinato (1990); Rel. 9–10, Vallone Mitta, Fiumara D'Agrò (31.12.17) (Sciandrello); Rel. 11–13, Torrente Ferruso, Antillo (9.7.2017) (Gianguzzi); Rel. 14, Fiumara Antillo, sotto l'abitato (9.7.2017) (Gianguzzi); Rel. 15, Affluente dell'Agrò in località Pinazzo, Antillo (29.10.2008) (Gianguzzi); Rel. 16–19, Torrente Fonderia, C.da Pianammare, Antillo (20.07.2018) (Sciandrello); Rel. 20–25, Torrente Fonderia, C.da Rosignolo, Antillo (26.07.2018) (Sciandrello).

Table 2. Rel. 1, Appennino pistoiese, Pistoia (10.7.2008) (Foggi et al.); Rel. 2, Appennino pistoiese, Pistoia (5.8.2008) (Foggi et al.); Rel. 3, Appennino pistoiese, Cutigliano (6.8.2008) (Foggi et al.); Rel. 4, Appennino pistoiese, San Marcello (6.8.2008) (Foggi et al.); Rel. 5, Appennino pistoiese, San Marcello (6.8.2008) (Foggi et al.); Rel. 6, Appennino pistoiese, Strada tra Torri di Popiglio e Pian degli Ontani, Piteglio (26.5.2009) (Foggi et al.); Rel. 7, Appennino pistoiese, Sopra Femminamorta, Marliana (31.7.2009) (Foggi et al.); Rel. 8, Appennino aretino, Alta Vallesanta, Chiusi della Verna (13.6.2009) (Raffaelli et al.); Rell. 9–31, Appennino pistoiese, Valli delle Limentre, Sambuca Pistoiese (15.6.2007) (Foggi, Venturi, Ferretti).

Table 3. Rel. 1, Appennino pistoiese, Marliana (28.4.2009) (Foggi et al.); Rel. 2, Appennino pistoiese, Pistoia (21.7.2009) (Foggi et al.); Rel. 3, Appennino pistoiese, Montale (22.7.2009) (Foggi et al.); Rel. 4, Appennino pistoiese, Montale (22.7.2009) (Foggi et al.); Rel. 5, Appennino pratese, Montemurlo (22.7.2009) (Foggi et al.); Rel. 6, Appennino pistoiese, Pistoia (30.7.2009) (Foggi et al.); Rel. 7, Appennino pistoiese, Pistoia (30.7.2009) (Foggi et al.); Rel. 8, Appennino pistoiese, Marliana (31.7.2009) (Foggi et al.); Rell. 9–11, Appennino pistoiese, Pescia (11.6.2009) (Foggi et al.); Rell. 12–14, Appennino aretino, Alta Vallesanta, Chiusi della Verna (04.7.2009) (Raffaelli et al.); Rel. 15, Appennino aretino, Alta Vallesanta, Chiusi della Verna (27.5.2009) (Raffaelli et al.); Rell. 16–17, Appennino aretino, Alta Vallesanta, Chiusi della Verna (12.6.2009) (Raffaelli et al.); Rel. 18, Appennino lucchese, Fosciandora (15.6.2007) (Gabellini et al.); Rel. 19, Appennino lucchese, Bagni di Lucca (3.7.1998) (Arrigoni and Papini); Rell. 20–21, Appennino lucchese, Bagni di Lucca (13.6.1999) (Arrigoni and Papini); Rel. 22, Appennino aretino, Pratomagno, Loro Ciuffenna (2007) (Gabellini); Rell. 23–24, Appennino aretino, Alta Val Tiberina, Pieve S. Stefano (17.8.2008) (Lastrucci et al.); Rel. 25, Appennino fiorentino, Londa (2004) (Gabellini); Rell. 26–8, Colline Metallifere senesi, Montieri (1996) (Gabellini).

References

1. Naiman, R.J.; Decamps, H.; Pollock, M. The Role of Riparian Corridors in Maintaining Regional Biodiversity. *Ecol. Appl.* **1993**, *3*, 209–212. [CrossRef] [PubMed]
2. Lowrance, R. The potential role of riparian forests as buffer zones. In *Buffer Zones: Their Processes and Potential in Water Protection*; Haycock, N., Burt, T., Goulding, K., Pinay, G., Eds.; Quest Environmental: Harpenden, UK, 1996; pp. 128–133.
3. Riis, T.; Kelly-Quinn, M.; Aguiar, F.C.; Manolaki, P.; Bruno, D.; Bejarano, M.D.; Clerici, N.; Fernandes, M.R.; Franco, J.C.; Pettit, N.; et al. Global Overview of Ecosystem Services Provided by Riparian Vegetation. *BioScience* **2020**, *70*, 501–514. [CrossRef]
4. European Commission. *Interpretation manual of European Union Habitats—EUR28*; European Commission DG Environment: Brussels, Belgium, 2013; pp. 1–144.
5. Cooper, S.D.; Lake, P.S.; Sabater, S.; Melack, J.M.; Sabo, J.L. The effects of land use changes on streams and rivers in mediterranean climates. *Hydrobiologia* **2013**, *719*, 383–425. [CrossRef]
6. Fois, M.; Cuena-Lombraña, A.; Bacchetta, G. Knowledge gaps and challenges for conservation of Mediterranean wetlands: Evidence from a comprehensive inventory and literature analysis for Sardinia. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2021**, *31*, 2621–2631. [CrossRef]
7. Ekka, A.; Pande, S.; Jiang, Y.; der Zaag, P. Anthropogenic Modifications and River Ecosystem Services: A Landscape Perspective. *Water* **2020**, *12*, 2706. [CrossRef]
8. González, E.; González-Sanchis, M.; Cabezas, A.; Comìn, F.A.; Muller, E. Recent changes in the riparian forest of a large regulated mediterranean river: Implications for management. *Environ. Manag.* **2010**, *45*, 669–681. [CrossRef]
9. Dierschke, H. Zur Syntaxonomischen Stellung und Gliederung der Ufer und Auenwälder Südeuropas. *Colloq. Phytosociol.* **1984**, *9*, 115–129.
10. Wallnöfer, S.; Mucina, L.; Grass, V. Querco-Fagetea. In *Die Pflanzengesellschaften Österreichs. Teil III. Wälder und Gebüsche*; Mucina, L., Grabherr, G., Wallnofer, S., Eds.; Gustav Fischer: Jena, Germany, 1993; pp. 85–236.

11. Douda, J. Svaz LBA Alnion incanae Pawlowski et al. 1928. In *Vegetace Ceske republiky 4. Lesnı a krovinna vegetace [Vegetation of the Czech Republic 4. Forest and Shrub vegetation]*; Chytry, M., Ed.; Academia: Praha, Czech Republic, 2013; pp. 198–219.
12. Mucina, L.; Bültmann, H.; Dierßen, K.; Theurillat, J.P.; Raus, T.; Čarni, A.; Šumberová, K.; Willner, W.; Dengler, J.; García, R.G.; et al. Vegetation of Europe: Hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. *Appl. Veg. Sci.* **2016**, *19*, 3–264. [CrossRef]
13. Passarge, H. Neue Vorschlage zur Systematik nordmitteleurop aischer Waldgesellschaften. *Feddes Repert.* **1968**, *77*, 75–103. [CrossRef]
14. Biurrun, I.; Campos, J.A.; García-Mijangos, I.; Herrera, M.; Loidi, J. Floodplain forests of the Iberian Peninsula: Vegetation classification and climatic features. *Appl. Veg. Sci.* **2016**, *19*, 336–354. [CrossRef]
15. Biondi, E.; Blasi, C.; Allegrezza, M.; Anzellotti, I.; Azzella, M.M.; Carli, E.; Casavecchia, S.; Copiz, R.; Del Vico, E.; Facioni, L.; et al. Plant communities of Italy: The Vegetation Prodrome. *Plant Biosyst.* **2014**, *148*, 728–814. [CrossRef]
16. Biondi, E.; Allegrezza, M.; Casavecchia, S.; Galdenzi, D.; Gasparri, R.; Pesaresi, S.; Poldini, L.; Sburlino, G.; Vagge, I.; Venanzoni, R. New syntaxonomic contribution to the Vegetation Prodrome of Italy. *Plant Biosyst.* **2015**, *149*, 603–615. [CrossRef]
17. Douda, J.; Boublík, K.; Slezák, M.; Biurrun, I.; Nociar, J.; Havrdová, A.; Doudová, J.; Aćić, S.; Brisse, H.; Brunet, J.; et al. Vegetation classification and biogeography of European floodplain forests and alder carrs. *Appl. Veg. Sci.* **2016**, *19*, 147–163. [CrossRef]
18. Rivas-Martínez, S.; Fuente, V.; Sánchez-Mata, D. Alisedas mediterráneo-iberoAtlanticas en la Península Iberica. *Stud. Bot.* **1986**, *5*, 9–38.
19. Dierschke, H. Die Schwarzerlen (Alnus glutinosa) Uferwälder Korsikas. *Phytocoenologia* **1975**, *2*, 229–243. [CrossRef]
20. Angius, R.; Bacchetta, G. Boschi e boscaglie ripariali del Sulcis-Iglesiente (Sardegna sud-occidentale, Italia). *Braun-Blanquetia* **2009**, *45*, 1–63.
21. Douda, J.; Doudová, J.; Drašnarová, A.; Kuneš, P.; Hadincová, V.; Krak, K.; Zákravský, P.; Mandák, B. Migration patterns of subgenus Alnus in Europe since the Last Glacial Maximum. A systematic review. *PLoS ONE* **2014**, *9*, e88709. [CrossRef]
22. Mandák, B.; Vít, P.; Krak, K.; Trávníček, P.; Havrdová, A.; Hadincová, V.; Zákravský, P.; Jarolímová, V.; Bacles, C.F.E.; Douda, J. Flow cytometry, microsatellites and niche models reveal the origins and geographical structure of Alnus glutinosa populations in Europe. *Ann. Bot.* **2016**, *117*, 107–120. [CrossRef]
23. Braun-Blanquet, J. *Pflanzensoziologie. Grundzüge der Vegetationskunde*, 3rd ed.; Springer: Wien, Austria, 1964; pp. 1–330.
24. Westhoff, V.; van der Mareel, E. The Braun Blanquet approach. In *Classification of Plant Communities*, 2nd ed.; Whittaker, R.H., Ed.; Dr Junk: The Hague, The Netherlands, 1978; pp. 287–399.
25. Dengler, J.; Berg, C.; Jansen, F. New ideas for modern phytosociological monographs. *Ann. Bot. (Roma)* **2005**, *5*, 193–210.
26. Dengler, J.; Chytrý, M.; Ewald, J. Phytosociology. In *Encyclopedia of Ecology*; Jørgensen, S.E., Fath, B.D., Eds.; Elsevier: Oxford, UK, 2008; pp. 2767–2779.
27. Biondi, E. Phytosociology today: Methodological and conceptual evolution. *Plant Biosyst.* **2011**, *145* (Suppl. S1), 19–29. [CrossRef]
28. Pott, R. Phytosociology: A modern geobotanical method. *Plant Biosyst.* **2011**, *145*, 9–18. [CrossRef]
29. Van der Maarel, E. Transformation of cover-abundance values in phytosociology and its effects on community similarity. *Vegetatio* **1979**, *39*, 97–114.
30. Bray, J.R.; Curtis, J.T. An ordination of the upland forest communities of southern Wisconsin. *Ecol. Monogr.* **1957**, *27*, 325–349. [CrossRef]
31. Ward, J.H. Hierarchical grouping to optimize an objective function. *J. Am. Stat. Assoc.* **1963**, *58*, 236–244. [CrossRef]
32. Maechler, M.; Rousseeuw, P.; Struyf, A.; Hubert, M.; Hornik, K.; Studer, M.; Roudier, P.; Gonzalez, J.; Kozlowski, K.; Schubert, E.; et al. Cluster: Cluster Analysis Basics and Extensions. R Package Version 2.1.1. Available online: https://CRAN.R-project.org/package=cluster (accessed on 15 October 2022).
33. McCune, B.; Mefford, M.J. *Multivariate Analysis of Ecological Data, version 6*; MjM Software PC-ORD: Gleneden Beach, OR, USA, 2011; pp. 1–34.
34. Fick, S.E.; Hijmans, R.J. WorldClim 2: New 1-km spatial resolution climate surfaces for global land areas. *Int. J. Climatol.* **2017**, *37*, 4302–4315. [CrossRef]
35. Tichý, L. JUICE, software for vegetation classification. *J. Veg. Sci.* **2002**, *13*, 451–453. [CrossRef]
36. Tichý, L.; Chytrý, M. Statistical determination of diagnostic species for site groups of unequal size. *J. Veg. Sci.* **2006**, *17*, 809–818. [CrossRef]
37. Arrigoni, P.V. Contributo alla conoscenza della vegetazione del Monte Gennargentu in Sardegna. *Boll. Soc. Sarda Sci. Nat.* **1986**, *25*, 63–96.
38. Arrigoni, P.V.; Di Tommaso, P.L.; Camarda, I.; Satta, V. La vegetazione dell'Azienda Forestale "Sa Pruna" (Dorgali—Sardegna centro-orientale). *Parlatorea* **1996**, *1*, 47–59.
39. Camarda, I.; Lucchese, F.; Pignatti Wikus, E.; Pignatti, S. La vegetazione dell'area Pantaleo-Gutturu Mannu-Punta Maxia-Monte Arcosu nel Sulcis-Iglesiente (Sardegna sud-occidentale). *Webbia* **1995**, *49*, 141–177. [CrossRef]
40. Blasi, C.; Frondoni, R. Frammenti di boschi igrofili nell'area tolfetano-cimina (Lazio). *Ann. Bot. (Roma)* **1996**, *54*, 171–182.
41. Stanisci, A.; Presti, G.; Blasi, C. I boschi igrofili del Parco Nazionale del Circeo (Italia centrale). *Ecol. Mediterr.* **1998**, *24*, 73–88. [CrossRef]
42. Ceschin, S.; Salerno, G. La vegetazione del basso corso del Fiume Tevere e dei suoi affluenti (Lazio, Italia). *Fitosociologia* **2008**, *45*, 39–74.

43. Di Pietro, R.; Azzella, M.M.; Facioni, L. The Forest Vegetation of the Tolfa-Ceriti Mountains (Northern Latium—Central Italy). *Hacquetia* **2010**, *9*, 91–150. [CrossRef]
44. Cutini, M.; Cancellieri, L.; Cioffi, M.T.; Licursi, C. Phytosociology and phytogeography of fragmented Alnus glutinosa forests in a Tyrrhenian district (Central Italy). *Ecol. Mediterr.* **2010**, *36*, 55–73. [CrossRef]
45. Arrigoni, P.V. Flora e vegetazione della Macchia lucchese di Viareggio (Toscana). *Webbia* **1990**, *44*, 1–62. [CrossRef]
46. Casini, S.; Chiarucci, A.; De Dominicis, V. Phytosociology and ecology of the Chianti woodlands. *Fitosociologia* **1995**, *29*, 115–136.
47. Arrigoni, P.V.; Papini, P. La vegetazione del sistema fluviale Lima—Serchio (Toscana meridionale). *Parlatorea* **2003**, *6*, 95–129.
48. Tomei, P.E.; Bertacchi, A.; Sani, A.; Consiglio, M. La vegetazione della Tenuta di San Rossore. Note esplicative della Carta della Vegetazione di San Rossore 1.10.000. Ente Parco Regionale Migliarino San Rossore. 2004.
49. Viciani, D.; Gabellini, A.; Gonnelli, V.; De Dominicis, V. La vegetazione della riserva naturale Monti Rognosi (Arezzo, Toscana) ed i suoi aspetti di interesse botanico-conservazionistico. *Atti Soc. Toscana Sci. Nat. Mem.* **2004**, *111*, 27–42.
50. Foggi, B.; Cartei, L.; Pignotti, L.; Signorini, M.A.; Viciani, D.; Dell'Olmo, L.; Menicagli, E. Il paesaggio vegetale dell'Isola d'Elba (Arcipelago Toscano). Studio fitosociologico e cartografico. *Fitosociologia* **2006**, *43*, 3–95.
51. Landi, M.; Angiolini, C. Osmundo-Alnion woods in Tuscany (Italy): A phytogeographical analysis from a west European perspective. *Plant Biosyst.* **2010**, *144*, 93–110. [CrossRef]
52. Lastrucci, L.; Paci, F.; Raffaelli, M. The wetland vegetation of the Natural Reserves and neighbouring stretches of the Arno river in the Arezzo province (Tuscany, Central Italy). *Fitosociologia* **2010**, *47*, 29–59.
53. Sani, A.; Monacci, F.; Trimarchi, S.; Tomei, P.E. La vegetazione della Tenuta di Migliarino. *Inter Nos.* **2011**, *2*, 5–72.
54. Francalancia, C.; Marconi, D. Ontanete ad Alnus glutinosa nei bacini dei fiumi Tronto, Tenna e Chienti. *Fitosociologia* **1994**, *27*, 91–95.
55. Gafta, D.; Pedrotti, F. Tipificazione di due nuove associazioni forestali ripariali per la penisola italiana. *Doc. Phytosociol.* **1996**, *15*, 413–415.
56. Taffetani, F.; Orlandini, S.; Zitti, S. Paesaggio vegetale di un'area pre-appenninica dell'Italia centrale: Il Bosco dei Monaci Bianchi nelle Marche (Italia). *Fitosociologia* **2009**, *46*, 27–47.
57. Biondi, E.; Baldoni, M. La vegetazione del fiume Marecchia (Italia Centrale). *Biogeographia* **1994**, *17*, 51–87. [CrossRef]
58. Rosati, L.; Di Pietro, R.; Blasi, C. La vegetazione forestale della Regione Temperata del "Flysch del Cilento" (Italia meridionale). *Fitosociologia* **2005**, *42*, 33–65.
59. Barbagallo, C.; Brullo, S.; Furnari, F.; Longhitano, N.; Signorello, P. *Studio fitosociologico e cartografia della vegetazione (1:25.000) del territorio di Serra S. Bruno (Calabria)*; CNR-AQ/1/227; Consiglio Nazionale delle Ricerche: Rome, Italy, 1982; pp. 1–19.
60. Brullo, S.; Spampinato, G. Indagine sulle ripisilve della Calabria (Italia meridionale). *Lazaroa* **1997**, *18*, 105–151.
61. Brullo, S.; Scelsi, F.; Spampinato, G. *La vegetazione dell'Aspromonte. Studio fitosociologico*; Laruffa Editore: Reggio Calabria, Italy, 2001; p. 372.
62. Brullo, S.; Spampinato, G. La vegetazione dei corsi d'acqua della Sicilia. *Boll. Acc. Gioenia Sci. Nat.* **1990**, *23*, 119–252.
63. Gamisans, J. La Végétation des Montagnes Corses. Ph.D. Thesis, University of Marseille, Marseille, France, 1975; 295p.
64. Gamisans, J. Forêts marécageuses, ripisylves et fruticées ripicoles de Corse. *Bull. Soc. Bot. Cent. Ouest* **2013**, *44*, 383–452.
65. Renaux, B.; Timbal, J.; Gauberville, C.; Thebaud, G.; Bardat, J.; Lalanne, A.; Royer, J.M.; Seytre, L. Contribution au Prodrome des végétations de France: Les Carpino betuli-Fagetea sylvaticae Jakucs 1967. *Doc. Phytosociol.* **2019**, *11*, 1–423.
66. Poldini, L.; Sburlino, G. Lamio orvalae-Alnetum glutinosae Dakskobler 2016, nuova associazione ripariale per L'Italia settentrionale (Friuli Venezia Giulia, Veneto, Lombardia) con note sulle corrispondenti cenosi poste a sud del Po. *Gortania* **2020**, *42*, 5–21.
67. Venanzoni, R.; Gigante, D. Contributo alla conoscenza della vegetazione degli ambienti umidi dell'Umbria (Italia). *Fitosociologia* **2000**, *37*, 13–63.
68. Catorci, A.; Orsomando, E. Note Illustrative Della Carta Della Vegetazione Del Foglio Nocera Umbra (N. 312-Carta d'Italia I.G.M.—1:50000). *Braun-Blanquetia* **2001**, *23*, 7–108.
69. Francalancia, C.; Orsomando, E. Les forets riveraines de la Valnerina (Italie Centrale). *Colloq. Phytosociol.* **1984**, *9*, 155–159.
70. Lastrucci, L.; Landucci, F.; Gonnelli, V.; Barocco, R.; Foggi, B.; Venanzoni, R. The vegetation of the upper and middle River Tiber (Central Italy). *Plant Sociol.* **2012**, *49*, 29–48.
71. Pirone, G. La vegetazione ripariale nei versanti nord-orientali del Gran Sasso d'Italia e dei Monti della Laga (Abruzzo, Italia). *Fitosociologia* **2000**, *37*, 65–86.
72. Pirone, G.; Ciaschetti, G.; Frattaroli, A.R.; Corbetta, F. La vegetazione della Riserva Naturale Regionale "Lago di Serranella" (Abruzzo—Italia). *Fitosociologia* **2003**, *40*, 55–71.
73. Bartolucci, F.; Peruzzi, L.; Galasso, G.; Albano, A.; Alessandrini, A.; Ardenghi, N.M.G.; Astuti, G.; Bacchetta, G.; Ballelli, S.; Banfi, E.; et al. An updated checklist of the vascular flora native to Italy. *Plant Biosyst.* **2018**, *152*, 179–303. [CrossRef]
74. Pignatti, S. Volume 1: Flora d'Italia & Flora Digitale. In *Flora d'Italia: In 4 Volumi*, 2nd ed.; Edagricole-Edizioni Agricole di New Business Media srl: Milano, Italy, 2017.
75. Pignatti, S. Volume 2: Flora d'Italia & Flora Digitale. In *Flora d'Italia: In 4 Volumi*, 2nd ed.; Edagricole-Edizioni Agricole di New Business Media srl: Milano, Italy, 2017.
76. Pignatti, S. Volume 3: Flora d'Italia & Flora Digitale. In *Flora d'Italia: In 4 Volumi*, 2nd ed.; Edagricole-Edizioni Agricole di New Business Media srl: Milano, Italy, 2018.

77. Pignatti, S.; Guarino, R.; La Rosa, M. Volume 4: Flora d'Italia & Flora Digitale. In *Flora d'Italia: In 4 Volumi*, 2nd ed.; Edagricole Edizioni Agricole di New Business Media srl: Milano, Italy, 2019.
78. Galasso, G.; Conti, F.; Peruzzi, L.; Ardenghi, N.M.G.; Banfi, E.; Celesti-Grapow, L.; Albano, A.; Alessandrini, A.; Bacchetta, G.; Ballelli, S.; et al. An updated checklist of the vascular flora alien to Italy. *Plant Biosyst.* **2018**, *152*, 556–592. [CrossRef]
79. Pesaresi, S.; Biondi, E.; Casavecchia, S. Bioclimate of Italy. *J. Maps* **2017**, *13*, 955–960. [CrossRef]
80. Theurillat, J.P.; Willner, W.; Fernández-González, F.; Bültmann, H.; Čarni, A.; Gigante, D.; Mucina, L.; Weber, H. International Code of Phytosociological Nomenclature. *Appl. Veg. Sci.* **2020**, *24*, e12491.
81. Andrew King, R.; Ferris, C. Chloroplast DNA phylogeography of *Alnus glutinosa* (L.) Gaertn. *Mol. Ecol.* **1998**, *7*, 1151–1161. [CrossRef]
82. Havrdová, A.; Douda, J.; Krak, K.; Vít, P.; Hadincová, V.; Zákravský, P.; Mandák, B. Higher genetic diversity in recolonized areas than in refugia of Alnus glutinosa triggered by continent-wide lineage admixture. *Mol. Ecol.* **2015**, *24*, 4759–4777. [CrossRef] [PubMed]
83. Mansion, G.; Rosenbaum, G.; Schoenenberger, N.; Bacchetta, G.; Rosselló, J.A.; Conti, E. Phylogenetic analysis informed by geological history supports multiple, sequential invasions of the Mediterranean Basin by the angiosperm family Araceae. *Syst. Biol.* **2008**, *57*, 269–285. [CrossRef] [PubMed]
84. Sciandrello, S.; Guarino, R.; Minissale, P.; Spampinato, G. The endemic vascular flora of Peloritani Mountains (NE Sicily): Plant functional traits and phytogeographical relationships in the most isolated and fragmentary micro-plate of the Alpine orogeny. *Plant Biosyst.* **2015**, *149*, 838–854. [CrossRef]
85. van Hinsbergen, D.J.J.; Torsvik, T.H.; Schmid, S.M.; Maţenco, L.C.; Maffione, M.; Vissers, R.L.M.; Gürer, D.; Spakman, W. Orogenic architecture of the Mediterranean region and kinematic reconstruction of its tectonic evolution since the Triassic. *Gondwana Res.* **2020**, *81*, 79–229. [CrossRef]
86. Rivas-Martınez, S.; Dıaz, T.E.; Fernandez-Gonzalez, F.; Izco, J.; Loidi, J.; Lousa, M.; Penas, A. Vascular plant communities of Spain and Portugal. Addenda to the syntaxonomical checklist of 2001. Part II. *Itinera Geobot.* **2002**, *15*, 433–922.
87. Berghen, V. Notes sur la végétation du sud-ouest de la France VIII. Les fourrés et les bois fangeux. *Bull. Jard. Bot. Nat. Belg.* **1971**, *41*, 283–395. [CrossRef]
88. Bacchetta, G.; Bagella, S.; Biondi, E.; Farris, E.; Filigheddu, R.; Mossa, L. Vegetazione forestale e serie di vegetazione della Sardegna (con rappresentazione cartografica alla scala 1:350.000). *Fitosociologia* **2009**, *46*, 3–82.
89. Brullo, S.; Marcenò, C. Contributo alla conoscenza della classe Quercetea ilicis in Sicilia. *Notiz. Soc. Fitosociol.* **1985**, *19*, 183–229.
90. Sciandrello, S.; Giusso del Galdo, G.; Salmeri, C.; Minissale, P. *Vicia brulloi* (Fabaceae), a new species from Sicily. *Phytotaxa* **2019**, *418*, 57–78. [CrossRef]
91. Brullo, S.; Cambria, S.; Crisafulli, A.; Tavilla, G.; Sciandrello, S. Taxonomic remarks on the *Centaurea aeolica* (Asteraceae) species complex. *Phytotaxa* **2021**, *483*, 9–24. [CrossRef]
92. Kajba, D.; Gracan, J. *EUFORGEN Technical guidelines for genetic conservation and use for black alder (Alnus glutinosa)*; International Plant Genetic Resources Institute: Rome, Italy, 2003; pp. 1–4.
93. Petit, Y.; Hugot, L. *Listes hiérarchisées des espèces végétales exotiques envahissantes et potentiellement envahissantes en Corse—Cadre méthodologique—Stratégie territoriale relative aux invasions biologiques végétales, Tome 1*; Conservatoire botanique national de Corse/Office de l'environnement de la Corse: Corse, France, 2019; pp. 1–29.
94. Reymann, J.; Panaïtis, C.; Bioret, F. Prodrome des végétations de Corse. *Doc. Phytosociol.* **2016**, *3*, 1–175.
95. Fenu, G.; Fois, M.; Cañadas, E.M.; Bacchetta, G. Using endemic-plant distribution, geology and geomorphology in biogeography: The case of Sardinia (Mediterranean Basin). *Syst. Biodivers.* **2014**, *12*, 181–193. [CrossRef]
96. Bacchetta, G.; Biondi, E.; Farris, E.; Filigheddu, R.; Mossa, L. A phytosociological study of the deciduous oak woods of Sardinia (Italy). *Fitosociologia* **2004**, *41*, 53–65.
97. Fantini, S.; Fois, M.; Casula, P.; Fenu, G.; Calvia, G.; Bacchetta, G. Structural heterogeneity and old-growthness: A first regional-scale assessment of Sardinian forests. *Ann. For. Res.* **2020**, *63*, 103–120. [CrossRef]
98. Clement, B.; Touffet, J. Contribution à l'étude des groupements préforestiers issus des landes méso-higrophiles, des tourbières et des prairies marécageuses de Bretagne. *Colloq. Phytosociol.* **1979**, *8*, 229–237.
99. Noirfalise, A.; Dethioux, M. Synopsis des forêts alluviales de Belgique. *Colloq. Phytosociol.* **1984**, *9*, 217–226.
100. Landi, M.; Frignani, F.; Bonini, I.; Casini, F.; Saveri, C.; De Dominicis, V.; Angiolini, C. Flora and vegetation in the catchment area of the stream "La Bolza" in the Merse valley (Siena, southern Tuscany). *Webbia* **2009**, *64*, 187–212. [CrossRef]
101. Landi, M.; Angiolini, C. Contributo alla conoscenza della distribuzione di Osmunda regalis L. in Toscana. *Inf. Bot. Ital.* **2007**, *39*, 113–122.
102. De Dominicis, V.; Casini, S. Memoria illustrativa per la carta della vegetazione della Val di Farma (Colline Metallifere). *Atti Soc. Toscana Sci. Nat. Mem. B* **1979**, *86*, 1–36.
103. Rivas-Martınez, S.; Fernandez-Gonzalez, F.; Loidi, J.; Lousa, M.; Penas, A. Syntaxonomical checklist of vascular plant communities of Spain and Portugal to association level. *Itinera Geobot.* **2001**, *14*, 5–341.
104. Spada, F. Primi lineamenti della vegetazione del comprensorio tolfetano-cerite. *Accad. Naz. Lincei (Roma)* **1977**, *227*, 37–50.
105. Montelucci, G. Note preliminari sulla flora e sulla vegetazione delle cerrete di Manziana e di Canale Monterano. *Acc. Naz. Lincei (Roma)* **1977**, *227*, 51–74.
106. Lucchese, F.; Pignatti, S. Sguardo sulla vegetazione del Lazio marittimo. *Accad. Naz. Lincei (Roma)* **1990**, *264*, 5–48.

107. Petriccione, B.; Pani, F. Primo contributo alla conoscenza sintassonomica dei boschi igrofili nel Lazio. *Ann. Bot. (Roma)* **1990**, *48*, 125–153.
108. Blasi, C.; Cutini, M.; Fortini, P.; Di Marzio, P. I boschi caducifogli del comprensorio Barbarano Romano-Canale Monterano (Lazio settentrionale). *Ann. Bot. (Roma)* **1995**, *51*, 279–296.
109. Montanari, C.; Gentile, S. Ricerche sulla vegetazione arbustiva e arborea di greto nei fiumi Vara e Magra (Liguria orientale). *Not. Fitosoc.* **1979**, *14*, 17–40.
110. Abbate, G.; Blasi, C.; Fascetti, S.; Michetti, L.; Filesi, L. *La vegetazione del parco suburbano Valle del Treja*; Tip. Borgia: Regione Lazio, Italy; Dip Biol. Vegetale Univ. "La Sapienza": Roma, Italy, 1990; pp. 1–32.
111. Biondi, E.; Baldoni, M. La vegetazione del fiume Esino (Marche-Italia centrale). *Stud. Bot.* **1993**, *11*, 209–257.
112. Tchou, Y.T. Études écologiques et phytosociologiques sur les fôrets riveraines du Bas-Languedoc (Populetum albae). *Vegetatio* **1946**, *1*, 2–28.
113. Oberdorfer, E. Der europäische Auenwald. *Beitr. Nat. Forsch. Südwestdtschl. Beih.* **1953**, *12*, 23–69.
114. Navarro, C. Contribución al estudio de la flora y vegetación del Duranguesado y la Busturia (Vizcaya). Ph.D. Thesis, Publ. Univ. Complutense de Madrid, Madrid, Spain, 1982; pp. 1–398.
115. Fukarek, P. Forest plant communites of Yugoslavia. In *Proc. Book of Second Congress of Ecologists of Yugoslavia*; Zadar-Plitvice, 1979; Volume 1, pp. 55–69.
116. Dakskobler, I. Phytosociological analysis of riverine forests in the Vipava and Reka Valleys (Southwestern Slovenia). *Folia Biol. Geol.* **2016**, *57*, 5–61. [CrossRef]
117. Spampinato, G.; Bernardo, L.; Passalacqua, N.G. Carta delle serie di vegetazione della Regione Calabria. In *La Vegetazione d'Italia*; Blasi, C., Ed.; Palombi Editori: Roma, Italy, 2010.
118. Spampinato, G.; Cameriere, P.; Caridi, D.; Crisafulli, A. Carta della biodiversità del Parco Nazionale dell'Aspromonte. *Quad. Bot. Ambient. Appl.* **2008**, *19*, 3–36.
119. Spampinato, G. Phytocoenotic diversity in Southern Italy. *Bocconea* **2009**, *23*, 33–49.
120. Maiorca, G.; Spampinato, G.; Crisafulli, A.; Cameriere, P. Flora vascolare e vegetazione della Riserva Naturale Regionale "Foce del Fiume Crati" (Calabria, Italia meridionale). *Webbia* **2007**, *62*, 121–174. [CrossRef]