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Coriaria myrtifolia-dominated vegetation: syntaxonomic considerations on a newly found community type in Tuscany (Italy)

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Abstract
During botanical researches, we found an isolated population of *Coriaria myrtifolia* for the first time in Tuscany (Italy). This study aims to gain insights into the distribution of this species and its associated vegetation. We studied the scrub vegetation dominated by *C. myrtifolia* at the currently known southernmost limit of its distribution in Italy through the phytosociological method. We present and discuss the attribution of the Tuscan relevés to the association *Rubo ulmifolii-Coriarietum myrtifoliae* O. de Bolòs 1954 (*Pruno spinosae-Rubion ulmifolii* O. de Bolòs 1954), firstly reported for peninsular Italy. Our data allowed us to describe a new subassociation *viburnetosum tini* differentiated by the Mediterranean shrub *Viburnum tinus* subsp. *tinus* and by the meso-xerophilous herbs *Lathyrus latifolius* and *Viola alba* subsp. *dehnhardtii*. This research also suggests that, although vast areas of Tuscany lie in the Temperate submediterranean macrobioclimate, including our study area, the presence of Mediterranean elements in the shrub vegetation can be conspicuous when local factors, such as a water body, mitigate the microclimate.

Key words: *Coriaria myrtifolia*, Habitat, Italy, Mediterranean Basin, *Pruno spinosae-Rubion ulmifolii*, syntaxonomy, vegetation.

Introduction

Scrub vegetation in Italy has been widely investigated in the last decades (Cutini *et al*., 1996; Cutini & Blasi, 1996; Blasi *et al*., 2000, 2002; Poldini, 2002; Poldini *et al*., 2002a, 2002b; Biondi *et al*., 2002a, 2002b, 2014a, 2014b, 2015). Among the typical species occurring in this vegetation type, there is a native one of particular interest since relatively rare in Italy (Pignatti *et al*., 2017-2019; Bartolucci *et al*., 2018): *Coriaria myrtifolia* L.

From the syntaxonomical perspective, de Bolòs (1962) indicated *Coriaria myrtifolia* as characteristic of the alliance *Pruno spinosae-Rubion ulmifolii* O. de Bolòs 1954, typical thermophilous scrub of high climatic and edaphic humidity. Later, Arnáiz (1983) considered this species characteristic of the thermo-mesomediterranean *Pruno-Rubenion ulmifolii* O. de Bolòs 1954 with a Mediterranean Levantine distribution. Then, other authors reported this suballiance as widespread in the Italian peninsula, in particular in the Tyrrhenian district (Blasi *et al*., 2002). More recently, *C. myrtifolia* was recognized as a diagnostic species of the class *Crataego-Prunetea* Tx. 1962 in Mucina *et al*. (2016). In Italy, it has been listed as characteristic species of the associations *Cytiso sessilifolii-Coriarietum myrtifoliae* Biondi *et al*. 1997 and *Rubo ulmifolii-Coriarietum myrtifoliae* O. de Bolòs 1954 and of the subassociation *coriarietosum myrtifoliae* Biondi *et al*. 1997 of the association *Spartio juncei-Hippophaëtum fluviatilis* Biondi *et al*. 1997 (Biondi *et al*., 1997; Vagge, 2002). *C. myrtifolia* is also indicated among the species present in plant communities of the Habitat 4030 (European dry heaths), 9330 (*Quercus suber* forests) and 3240 (Alpine rivers and their ligneous vegetation with *Salix eleagnos*) of Annex I of the 92/43/EEC Habitats Directive (Molina *et al*., 2004; Biondi *et al*., 2009; Gigante *et al*., 2016, 2018; Agrillo *et al*., 2018).

To contribute to a better knowledge of Italian vegetation at fine-scale, we (1) discuss the origin of this population in relation to the distribution of the species, and (2) describe the vegetation context of the newly found *C. myrtifolia*-dominated vegetation in Tuscany.

Materials and methods

Species of interest

The genus *Coriaria* belongs to the monogeneric family of *Coriariaceae* (Pignatti *et al*., 2017-2019). This family of dicotyledons of the order *Cucurbitales* includes about 17 species and occurs scattered from Japan to Philippines, in China (in the Himalayan mountain

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range), from New Guinea to New Zealand (including the South Pacific islands), from Mexico to Chile and in the western Mediterranean areas (Oginuma *et al*., 1991; Govaerts, 2003; Kubitzki, 2010). In Europe, *Coriaria* is a monospecific genus with the only representative *C. myrtifolia* (Pignatti *et al*., 2017-2019). This deciduous phanerophyte has a prevalently shrubby habitus. In the Mediterranean, the species is mainly distributed in the western part, i.e. in Algeria, Morocco, Spain, France, Italy, and Greece. In Euro+Med PlantBase (Euro+Med, 2006; Raab-Straube, 2014), it is considered a naturalized alien in Portugal and reported as doubtfully native in Tunisia. The new Italian checklist of native flora (Bartolucci *et al*., 2018), reports the species for three northern Italian administrative regions (i.e. Liguria, Emilia-Romagna, and Piedmont). In other areas (i.e. Friuli Venezia Giulia and Veneto), *C. myrtifolia* is reported as alien and casual alien, respectively (Galasso *et al*., 2018). The easternmost known native locality of *C. myrtifolia* in Italy is at the northern Apennines near Parma, where it grows in the riverbed of Taro river (Ferrarini, 1987; Biondi *et al*., 1997). The southernmost distribution limit is at the area of Sanremo (Imperia; Barberis *et al*., 2016).

In Italy, *C. myrtifolia* thrives on dry stony slopes, on pebbly riverbeds, and cliffs up to 900 m a.s.l. (Pignatti *et al*., 2017-2019), but can occur in other habitats, such as dry woodlands and pastures, in different areas of the Mediterranean Basin (Good, 1930).

Study area

The study area is situated in southern Tuscany in the municipality of Castellina in Chianti (Siena), at a locality called San Leonino. It is excluded from any protected area, but it is placed nearby two Sites of Community Importance, i.e. "Monti del Chianti" (IT5190002) and "Montagnola Senese" (IT5190003). The study area corresponds to the buffer zone of the San Leonino lake at about 290 m a.s.l. (43.417038° N, 11.290849° E; Fig. 1), where vegetation dominated or co-dominated by *Coriaria myrtifolia* is present (Fig. 2a, 2b). The lake is a waterbody which arose from the construction of a small dam along the river Gena. The dam was built between the years 1959 and 1962. Therefore, this lake has not a natural origin, while the river is natural.

The study area is placed in a hilly zone, which rapidly turns into flatlands a few kilometres apart in the southwestern direction. The geology consists of alluvial Holocene deposits of gravel, sand, and silt along the riverbed, while the slopes are made up of Messinian post-evaporitic conglomerate and sandstone deposits (Regione Toscana, 2019). The study area is placed in the Temperate (submediterranean) macrobioclimatic region, in the Oceanic (submediterranean) bioclimate. It is characterized by a strong submediterraneity index, a weak semicontinentality, a mesotemperate thermotype, and a subhumid ombrotype (Pesaresi *et al*., 2014, 2017).

The lake is surrounded by thermophilous evergreen and deciduous oak woodlands dominated by *Quercus ilex* subsp. *ilex* and *Q. pubescens*, mainly on the southeast and north-west facing-slopes of the lake, respectively. Between woodland formations and aquatic vegetation, scrub vegetation with *C. myrtifolia* thrives (Fig. 2c). The whole area is set in an agricultural context. Olive groves and vineyards occur in the surroundings.

Field sampling

We performed a phytosociological survey using the Braun-Blanquet (1932) approach to investigate the vegetation where *Coriaria myrtifolia* is dominant or co-dominant. We performed the field survey during the vegetation optimum of spring 2018, overall collecting 13 relevés around the lake.

Analyses

To obtain more insights about the current and past distribution of the species in Italy, we analysed herbarium specimens present at relevant Italian herbaria (FI, GE, MSU, RO, SIENA, TO; acronym according to Thiers, 2015).

To clarify the syntaxonomic position of *Coriaria myrtifolia*-dominated vegetation found in Tuscany (relevés n = 13), we prepared a comparative dataset with relevés of *C. myrtifolia* vegetation from Tuscany and all literature sources known for Italy, at the best of our knowledge (Appendix I). These relevés included data from: (i) Emilia-Romagna (Biondi *et al*., 1997; no. 3 relevés, rels. 7-9 in Tab. 34 - *Spartio*

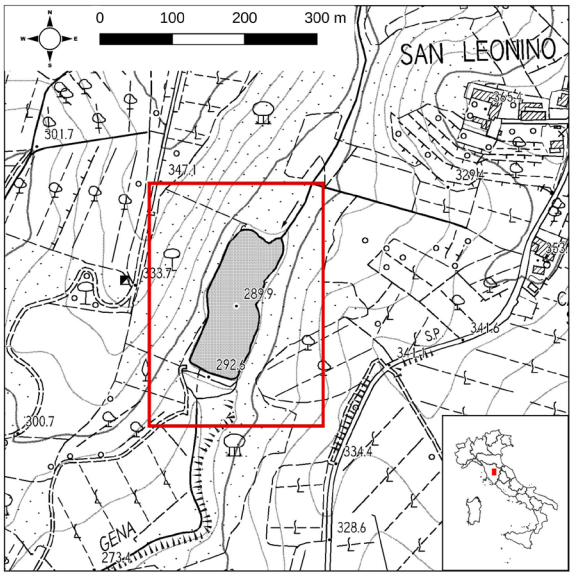

Fig. 1 - Study area (central box) located at San Leonino (Siena, Tuscany) and its position in respect to Italy (box in the bottom right corner). Base map (1:10000) is taken from Regione Toscana (2019).

juncei-Hippophaëtum fluviatilis coriarietosum myrtifoliae Biondi *et al*. 1997 and no. 9, rels. 1-9 in Tab. 35 - *Cytiso sessilifolii-Coriarietum myrtifoliae* Biondi *et al*. 1997); (ii) Liguria 1 (Vagge, 2002; no. 9, rels. 1-9 in Tab. 1 - *Cytiso sessilifolii-Coriarietum myrtifoliae* Biondi *et al*. 1997); Liguria 2 (de Bolòs, 1970; no. 3, rels. 1-3 in Tab. 4 - *Rubo ulmifolii-Coriarietum myrtifoliae ostryetosum carpinifoliae* O. de Bolòs 1970; 2 of these relevés were sampled next to the Italian border, i.e. at Gorbio, France). The full matrix contained 37 relevés and 110 species. For the purpose of all analyses, we deleted species which were present only in one relevé (n = 35). In this matrix, the Braun-Blanquet cover values were transformed into mid percentage values of individual grades. We first performed a cluster analysis of the plots by TWINSPAN using twinspan package (Oksanen & Hill, 2019). We used 5 pseudospecies cut levels (0%, 2%, 5%, 25%, 50%) of species percentage cover. Then, to explore general patterns of communities and to highlight changes in species composition among groups, we run a principal coordinate analysis (PCoA) of the dataset using the vegan package (Oksanen *et al*., 2019). The PCoA model was based on the square-root transformed Bray-Curtis dissimilarity matrix, which was calculated on square-root transformed cover values. Based on the permutation test (p-value ≤ 0.001) we chose the best-fitted species and projected them in the ordination diagram.

The nomenclature follows Bartolucci *et al*. (2018) for native species and Galasso *et al*. (2018) for alien species. We identified the plants using the Flora of Italy and the Flora d'Italia Digitale (Pignatti *et al*., 2017-2019). All the analyses were performed in R v. 3.6 (R Core Team, 2019).

Results

We retrieved 48 herbarium specimens in 6 Italian herbaria from 5 Italian administrative regions (Appendix II).

The thirteen original phytosociological relevés of *Coriaria myrtifolia*-dominated or co-dominated vegetation are shown in Tab. 1 (sporadic species are listed in Appendix II). Overall, we recorded 56 species of vascular plants. Among them, only one species has to be considered a naturalized alien (*Galega officinalis*). Beside *C. myrtifolia*, present in all relevés, the most common species found were *Rubia peregrina* (11), *Cornus sanguinea* subsp. *hungarica* and *Hedera helix* subsp. *helix* (10), *Juniperus communis*, *Viburnum*

Fig. 2 - *Coriaria myrtifolia* L. found at San Leonino (Siena): A) *C. myrtifolia*-dominated vegetation; B) Close-up picture of *C. myrtifolia*-dominated vegetation; C) Environmental context; D) *C. myrtifolia* fruits.

Tab. 1 - Tuscan phytosociological relevés (co-)dominated by *Coriaria myrtifolia* ascribed to *Rubo ulmifolii-Coriarietum myrtifoliae* O. de Bolòs 1954 *viburnetosum tini* subass. nova (rel. 1 = *holotypus*; *Pruno-Rubenion ulmifolii* O. de Bolòs 1954, *Pruno spinosae-Rubion ulmifolii* O. de Bolòs 1954). Sporadic species are reported in Appendix II.

No. relevé	1*	2	3	4	5	6	7	8	9	10	11	12	13	
Area (m^2)	4	4	4	4	3	4	6	4	3	3	4	3	2	
Aspect (°)	90	90	90	90	90	90	90	90	90	90	360	270	270	
Slope (%)	10	15	5	10	30	10	10	30	5	5	5	5	5	
Total cover (%)	95	100	100	90	75	70	100	90	100	95	100	90	100	
Cover of shrubs (%)	80	95	100	75	70	60	95	80	100	80	80	80	90	
Cover of herbs (%)	50	10	25	60	15	20	15	85	5	40	40	40	20	
Cover of bryophytes (%)	-	-	-	-	-	60	-	-	-	-	-	-	-	
Shrub height (m)	2.5	2	2	1	1.5	1	1.5	1.5	2.5	1.5	2	2	1.5	
Distance from the lake (m)	2	0.5	10	4	3	5	5	2	0.5	1	1	0.5	0.5	
Metres above the lake surface (m)	1	0.5	3	5	4	6	2	5	0.5	0.5	0.5	0.5	0.5	
No. of species	17	14	16	15	16	20	19	11	22	17	18	16	16	Presences
Characteristic species of association, suballiance, and alliance														
Coriaria myrtifolia L.	4	3	3	4	3	3	4	4	4	3	3	4	4	13
Rubia peregrina L.	+	.	1	1	+	+	+	1	2	1	.	+	2	11
Cornus sanguinea L. subsp. hungarica (Kárpáti) Soó	2	1	2	.	+	.	.	+	+	3	2	2	+	10
Juniperus communis L.	.	.	+	2	1	2	+	+	2	.	.	+	2	9
Dioscorea communis (L.) Caddick & Wilkin	.	.	2	+	.	+	.	.	.	.	2	1	2	6
Rubus ulmifolius Schott	1	.	2	.	.	.	.	.	.	2	3	2	.	5
Ligustrum vulgare L.	+	1	3	.	.	.	.	+	.	.	.	.	.	4
Pyracantha coccinea M.Roem.	.	.	.	+	.	+	.	.	.	.	1	.	1	4
Rhamnus alaternus L. subsp. alaternus	1	2	.	.	.	.	+	.	.	.	.	.	.	3
Rosa sempervirens L.	.	.	.	.	.	.	.	1	1	+	.	.	.	3
Differential species of subassociation														
Viburnum tinus L. subsp. tinus	2	3	2	2	+	1	+	+	3	2	.	.	.	9
Viola alba Besser subsp. dehnhardtii (Ten.) W.Becker	+	+	.	+	.	+	+	.	+	.	.	+	.	7
Lathyrus latifolius L.	+	+	.	.	.	.	.	.	.	1	1	1	1	6
Species of higher syntaxa														
Spartium junceum L.	.	2	.	.	.	.	2	.	.	.	1	.	.	3
Lonicera etrusca Santi	.	.	1	.	+	.	.	.	.	.	.	.	.	2
Lonicera caprifolium L.	.	.	.	+	.	.	.	.	.	.	.	.	+	2
Rosa canina L.	.	+	3	.	.	.	.	.	.	.	.	.	.	2
Prunus spinosa L. subsp. spinosa	.	.	.	.	.	.	.	.	.	.	3	.	.	1
Other species														
Hedera helix L. subsp. helix	1	+	2	3	1	1	+	.	+	.	.	2	+	10
Brachypodium rupestre (Host) Roem. & Schult.	2	2	1	+	1	+	2	.	+	1	.	.	.	9
Carex flacca Schreb. subsp. flacca	.	1	2	+	+	1	.	1	+	.	2	+	.	9
Quercus ilex L. subsp. ilex	.	.	.	+	1	1	2	+	2	1	.	.	.	7
Convolvulus sepium L.	+	+	.	.	.	1	.	.	.	.	1	1	1	6
Quercus pubescens Willd. subsp. pubescens	.	.	+	1	.	+	+	.	+	.	.	.	1	6
Osyris alba L.	.	+	2	1	1	+	1	.	.	.	.	.	.	6
Eupatorium cannabinum L. subsp. cannabinum	2	.	.	3	3	2	.	.	+	.	.	.	.	5
Juncus effusus L. subsp. effusus	.	.	.	.	.	.	.	.	.	1	1	1	1	4
Astragalus monspessulanus L. subsp. monspessulanus	.	.	.	.	.	.	.	.	+	2	2	.	+	4
Equisetum ramosissimum Desf.	1	.	.	.	1	+	.	.	+	.	.	.	.	4
Brachypodium sylvaticum (Huds.) P.Beauv. subsp. sylvaticum	.	.	.	.	+	1	+	.	.	.	.	.	.	3
Cephalanthera rubra (L.) Rich.	.	.	.	.	.	.	.	.	.	.	+	1	2	3
Cistus creticus L. subsp. eriocephalus (Viv.) Greuter & Burdet	+	.	.	.	.	+	.	+	.	.	.	.	.	3
Dactylis glomerata L. subsp. hispanica (Roth) Nyman	.	.	.	.	1	+	+	.	.	.	.	.	.	3
Lotus hirsutus L.	.	.	1	.	.	.	+	.	+	.	.	.	.	3
Lotus corniculatus L.	.	.	.	.	.	.	.	.	+	1	.	.	+	3
Mentha aquatica L. subsp. aquatica	.	.	.	.	+	.	+	.	+	.	.	.	.	3
Pulicaria dysenterica (L.) Bernh.	+	.	.	.	.	.	.	.	.	1	1	.	.	3
Carduus pycnocephalus L. subsp. pycnocephalus	+	.	.	.	.	.	.	.	.	1	.	.	1	3
Sporadic species	1	1	.	.	1	1	3	1	4	3	5	4	1	

tinus subsp. *tinus*, *Brachypodium rupestre*, and *Carex flacca* subsp. *flacca* (9).

Through the cluster analysis, we identified 2 main groups with relevés of Tuscany clearly separated from those of Liguria and Emilia-Romagna, with only one minor exception of one relevé of de Bolòs (1970) sampled at Arma di Taggia (Liguria) linked to Tuscan relevés (Fig. 3; Fig. A in Appendix II). The first two axes of the PCoA ordination of Italian relevés with *C. myrtifolia* explained a variance of ~25%, showing the relevés originally referred to *Cytiso sessilifolii-Coriarietum myrtifoliae* Biondi *et al*. 1997 and *Spartio juncei-Hippophaëtum fluviatilis coriarietosum myrtifoliae* Biondi *et al*. 1997, clearly separated from the Tuscan ones along the first axis (Fig. 3; Fig. A in Appendix II). On the contrary, the *Rubo ulmifolii-Coriarietum myrtifoliae ostryetosum carpinifoliae* O. de Bolòs 1970, found at Gorbio (France) by de Bolòs

(1970), appeared to be at an intermediate position, although displaced towards the *C. myrtifolia* vegetation found in the Tuscan hills. The cluster analysis together with the best-fitted species reported in the ordination diagram clearly showed the originality of the Tuscan relevés from a floristic point of view. They were differentiated by Mediterranean thermophilous species as *Rubia peregrina*, *Quercus ilex* subsp. *ilex*, and *Viburnum tinus* subsp. *tinus* with respect to *Cytiso sessilifolii-Coriarietum myrtifoliae* Biondi *et al*. 1997 and *Spartio juncei-Hippophaëtum coriarietosum myrtifoliae* Biondi *et al*. 1997, characterized in turn by species with (southern-)European distribution, such as *Cytisus sessilifolius* and *Clematis vitalba*.

Discussion

During floristic and vegetation researches in summer 2018, we found a new isolated population of *Coriaria myrtifolia* in the Chianti hills (Tuscany, Italy). The population thrives around lakeshores, especially on the eastern side, extending for about one hectare and hosting approximately 100-150 individuals. Although the lake is artificial (about 60 years old), the area shows a relatively low disturbance. The human impact is limited to the few paths present and the fishing-sites next to the lake used by fishermen. The finding of this species represents a novelty for the woody flora of Tuscany (Roma-Marzio *et al*., 2016), thus enlarging its distribution range, being at the southernmost currently-known occurrence in Peninsular Italy.

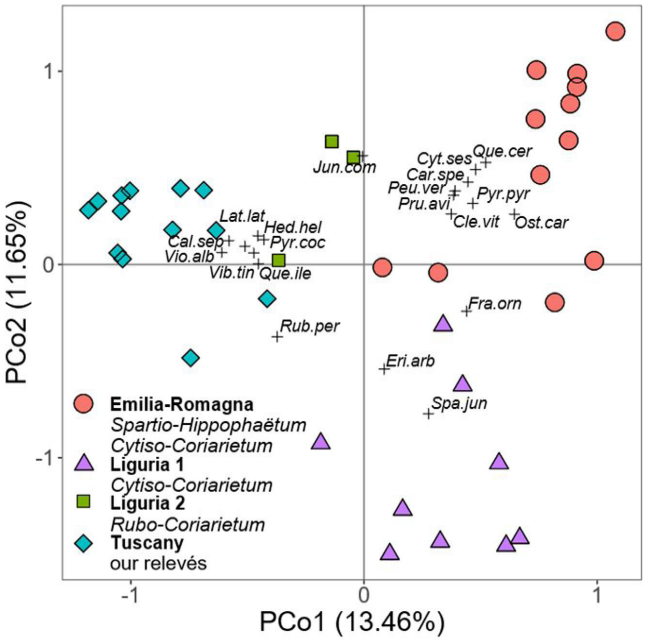

Fig. 3 - PcoA diagram of *Coriaria myrtifolia*-dominated communities, showing the best-fitted species. The full names of the plant species are reported in Tab. 1.

Distribution

The genus *Coriaria* is worldwide characterized by a unique degree of geographical discontinuity (Good, 1930). To better comprehend the distribution of this species, a broad scale should be taken into account. *C. myrtifolia* shows a decreasing gradient of occurrence in the Mediterranean Basin from west to east. This is reflected in the presence/absence of the species in conservation lists. For example, *C. myrtifolia* is not protected in Spain and France where it is relatively widespread in riparian habitats close to the Mediterranean coasts. On the contrary, in Greece, where the species finds its easternmost distribution limit, it has a somewhat scattered distribution. For this reason, it is also included in the national red list as a vulnerable species (Giannitsaros & Vasileiadis, 2009). In Italy, the species has been selected for the identification of important areas for plants concerning Liguria (Blasi *et al*., 2010). Seeing the distribution range in Italy based on the herbarium specimens retrieved (Appendix II), the presence of the species in southern Tuscany is not unlikely, especially considering the similar latitude with populations of Liguria and that the species was likely present in other parts of Italy in the past and now probably extinct. Moreover, the closest Italian site is just a few hundred kilometres apart, i.e. at Berceto, Parma (Italy; Ferrarini, 1987; Biondi *et al*., 1997). Furthermore, the analysis of the herbarium specimens (Appendix II) showed that the species was maybe present also in Sicily at the end of the 19th century as collected by Lojacono in the vicinity of Palermo. In that case, the collector seemed questioning, by using a question mark, about the apparent indigenous status of the species. However, *C. myrtifolia* is still now occurring in northern Africa (Euro+Med, 2006; Raab-Straube, 2014). In this context, genetic analyses might help to disentangle this issue. Unfortunately, no chromosomes counts exist for Italian populations, whereas those of Morocco report 2n = 80 (Oginuma *et al*., 1991). Though, we argue that the distribution in peninsular Italy, as well as in other parts of Italy, can be possibly influenced by the colonizing character of the species. This perspective might support the explanation of several findings, subsequently not confirmed. For instance, *C. myrtifolia* has been reported already in Trieste area as feral (Marchesetti, 1897; Pospichal, 1899; Poldini, 1991), but not confirmed afterwards (Poldini *et al*., 2001; Poldini, 2002, 2009). Moreover, a convincing proof of the dispersability of *Coriaria* spp. diaspores is provided by its occurrence on remote and geologically young volcanic islands (Kubitzki, 2010). Although *C. myrtifolia* is considered poisonous for mammals, there is evidence that the fruits of the genus *Coriaria* are eaten by birds (Ridley, 1930; Kubitzki, 2010). The fruits in this species are fleshy, clearly visible, with a colour ranging from red to black (Fig. 2d),

which is an attractive feature for these animals. In addition, the seeds have a thick and hard pericarp that allow them to pass through the digestive system of birds. All these features can help the plant in its dissemination through a successful endozoochory strategy that facilitates *C. myrtifolia* to colonize new areas. Lastly, species of *Coriaria* seem never to be deliberately cultivated (Good, 1930).

Vegetation and habitat

The discovery of *Coriaria myrtifolia*-dominated communities in Tuscany represents a novelty from the vegetation point of view. At our study site, *C. myrtifolia* has its vegetation optimum in the strip bordering the water at about 1-5 m distance from the lake where we found the biggest individuals, although the species is not directly related to the water, in contact with hygrophilous coenoses. Interestingly, it has never been reported from comparable vegetation systems around the lakes of central Italy (Azzella *et al*., 2017; Lastrucci *et al*., 2014, 2017, 2019). Rather, the thermophilous scrub vegetation with *C. myrtifolia* is possibly a dynamic stage of *Quercus ilex* subsp. *ilex* and *Q. pubescens* woodlands. The most common species found in the sampled vegetation were shrubs (e.g. *Cornus sanguinea* subsp. *hungarica*, *Juniperus communis*, *Rubus ulmifolius*, *Viburnum tinus* subsp. *tinus*) and lianas (e.g. *Dioscorea communis*, *Hedera helix* subsp. *helix*, *Rubia peregrina*).

Comparing our data to what is described in the literature (de Bolòs, 1954; Rivas Martínez *et al*., 1992; Biondi *et al*., 1997; Vagge, 2002), *Coriaria myrtifolia* appears inserted in its typical phytosociological context in Tuscany. Our analyses attempted a comparison of Tuscan data with similar Italian vegetation types with *C. myrtifolia* ascribed to the syntaxa *Cytiso sessilifolii-Coriaretum myrtifoliae* Biondi *et al*. 1997, *Rubo ulmifolii-Coriarietum myrtifoliae ostryetosum carpinifoliae* O. de Bolòs 1970, and *Spartio juncei-Hippophaëtum fluviatilis coriarietosum myrtifoliae* Biondi *et al*. 1997.

The Tuscan relevés clearly resulted separated from *Cytiso sessilifolii-Coriarietum myrtifoliae* Biondi *et al*. 1997, considered an Apenninic vicariant of the *Rubo ulmifolii-Coriarietum myrtifoliae* O. de Bolòs 1954, the former described to frame the scrub vegetation dynamically related to *Ostrya carpinifolia* woodlands on slopes between 400 and 750 m a.s.l. (Biondi *et al*., 1997). Our relevés are linked to *Quercus ilex* subsp. *ilex* and/or *Quercus pubescens* subsp. *pubescens* woodlands at about 300 m a.s.l. and they have latitudinal, ecological and floristic affinities with the thermo-mesomediterranean scrub vegetation of *Rubo ulmifolii-Coriarietum myrtifoliae* O. de Bolòs 1954 (*Pruno spinosae-Rubion ulmifolii* O. de Bolòs 1954; *Pruno-Rubenion ulmifolii* O. de Bolòs 1954), especially considering the presence of Mediterranean shrubs such as *Rhamnus alaternus*, *Rosa sempervirens*, *Rubia peregrina* and *Viburnum tinus* subsp. *tinus*. These species, have been indicated as differentials by de Bolòs (1954) in respect to the more mesophilic *Pruno spinosae-Ligustretum vulgaris* Tx. 1952, but they are also differential with respect to *Cytiso sessilifolii-Coriarietum myrtifoliae* Biondi *et al*. 1997 in our study. *Rubo ulmifolii-Coriarietum myrtifoliae* O. de Bolòs 1954 has already been found in western Liguria, France (de Bolòs, 1970) and eastern Spain (de Bolòs, 1954; Rivas Martínez *et al*., 1992; Loidi, 2017a; 2017b; SIVIM, 2019) and has probably to be considered a thermophilous vicariant of *Cytiso sessilifolii-Coriarietum myrtifoliae* Biondi *et al*. 1997. However, both associations seem to occur in Liguria (Vagge, 2002). The results of the ordination are in accordance with this interpretation showing an opposite bioclimatic and biogeographic gradient. *Rubo ulmifolii-Coriarietum myrtifoliae* O. de Bolòs 1954 shows a Mediterranean character, while *Cytiso sessilifolii-Coriarietum myrtifoliae* Biondi *et al*. 1997 displays a relatively European character. However, our classification indicated a differentiation of the Tuscan relevés along axis 2 in respect to *Rubo ulmifolii-Coriarietum myrtifoliae ostryetosum carpinifoliae* O. de Bolòs 1970 found in France due to the abundance of Mediterranean shrubs that are likely favoured by the mitigating effect of the nearby water body. This feature allows us to describe a new subassociation *viburnetosum tini* subass. nova (*holotypus* rel. 1 in Tab. 1; subass. *typicum* rel. 4 in Tab. 10 de Bolòs (1954) [Art. 5]) differentiated by *Viburnum tinus* subsp. *tinus* that underlines the Mediterranean character of the shrub community, while among the herbs, *Lathyrus latifolius* and *Viola alba* subsp. *dehnhardtii*, favoured by the macrobioclimate, indicate the Temperate submediterranean character of the syntaxon.

At higher syntaxonomic rank, the target vegetation of this study was ascribed to the class *Crataego-Prunetea* Tx. 1962, consisting of scrub vegetation seral or marginal to broad-leaved woodlands in the nemoral zone and the submediterranean regions of Europe. We also framed our data in the order *Pyro spinosae-Rubetalia ulmifolii* Biondi, Blasi et Casavecchia in Biondi *et al*. 2014, consisting of Mediterranean and sub-Mediterranean shrub vegetation with abundant *Rubus ulmifolius*, following the vegetation classification of Italy (Biondi *et al*., 2014b) and Europe (Mucina *et al*., 2016).

From a Habitat perspective, the shrub communities with *C. myrtifolia* found in Tuscany cannot be attributed to any type of protected habitat following the Annex I of the 92/43/EEC Habitats Directive (Gigante *et al*., 2019). As stressed by many authors (e.g. Biondi *et al*., 2014b; Lastrucci *et al*., 2014; Gigante *et al*., 2016), several habitats of conservation importance were not included in the Annex I of the 92/43/EEC Habitats Directive, probably due to their large distribution in

non-Mediterranean areas (Angiolini *et al*., 2017). Nevertheless, they represent valuable habitats from a floristic, vegetation and conservation viewpoints and they need recognition, at least, in regional legislation. Specific vegetation types as *C. myrtifolia* community, are extremely remarkable in some areas because of their rarity and vulnerability.

Conclusions

The discovery of *Coriaria myrtifolia* and associated *C. myrtifolia*-dominated vegetation in Tuscany represents an important new finding, being the southernmost occurrence currently known in peninsular Italy. In the study area, the species performs as dominant or co-dominant in the scrub vegetation, in dynamic contact with woodland formations. This research suggests that, although vast areas of Tuscany lie in the Temperate submediterranean macrobioclimate, including our study area, the presence of Mediterranean elements in the shrub vegetation can be conspicuous when local factors, such as the vicinity of a water body, mitigate the microclimate. Our data allowed us to classify our relevés to the association *Rubo ulmifolii-Coriarietum myrtifoliae* O. de Bolòs 1954, firstly reported for peninsular Italy, and to describe a new subassociation *viburnetosum tini* with a distinctly Mediterranean character.

This study opens the way to the research of other populations of *C. myrtifolia* in Italy in similar environmental conditions given the colonizing habit of this species. We encourage further investigation to evaluate the population structure and chromosome counts, these latter currently lacking for the Italian populations. Concerning conservation issues, the assessment of *C. myrtifolia* conservation status is desirable for its potential inclusion in national or regional red lists of species and habitats.

Syntaxonomic scheme

CRATAEGO-PRUNETEA Tx. 1962
PYRO SPINOSAE-RUBETALIA ULMIFOLII Biondi, Blasi et Casavecchia in Biondi *et al*. 2014
Pruno spinosae-Rubion ulmifolii O. de Bolòs 1954
Pruno-Rubenion ulmifolii O. de Bolòs 1954
Rubo ulmifolii-Coriarietum myrtifoliae O. de Bolòs 1954
viburnetosum tini Bonari et Angiolini subass. nova (*holotypus* rel. 1 in Tab. 1)

Other syntaxa quoted in the text

Cytision sessilifolii Biondi in Biondi *et al*. 1989; *Cytiso sessilifolii-Coriarietum myrtifoliae* Biondi *et al*. 1997; *Prunetalia spinosae* Tx. 1952; *Pruno spinosae-Ligustretum vulgaris* Tx. 1952; *Spartio juncei-Hippophaëtum fluviatilis coriarietosum myrtifoliae* Biondi *et al*. 1997; *Rubo ulmifolii-Coriarietum myrtifoliae ostryetosum carpinifoliae* O. de Bolòs 1970.

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Appendix I - Table S1

The full table of phytosociological relevés used in the ordination. (-) indicates a missing value. I = Italy; F = France.

	Original data													Biondi *et al*., 1997											Vagge, 2002								de Bolòs, 1970		
# in the original table	1	2	3	4	5	6	7	8	9	10	11	12	13	7	8	9	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	-	-	-
Country	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	F	F	I
Altitude (m)	291	291	293	296	289	289	292	308	302	299	290	290	290	103	122	245	475	750	750	580	470	600	590	350	360	320	240	240	465	450	470	460	400	450	-	-	-
Aspect (degrees)	90	90	90	90	90	90	90	90	90	90	360	270	270	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Slope (degrees)	10	15	5	10	30	10	10	30	5	5	5	5	5	-	-	-	30	25	35	30	40	20	20	30	25	30	20	20	40	30	25	15	20	30	-	-	-
Acer campestre L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Achnatherum calamagrostis (L.) P.Beauv.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aegonychon purpurocaeruleum (L.) Holub	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ajuga reptans L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemisia alba Turra	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus monspessulanus L. subsp. monspessulanus	.	.	.	.	.	.	.	.	+	2	2	.	+	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bituminaria bituminosa (L.) C.H.Stirt.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Brachypodium pinnatum (L.) P.Beauv.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Brachypodium rupestre (Host) Roem. & Schult.	2	2	1	+	1	+	2	.	+	1	.	.	.	.	.	.	.	2	2	+	.	2	1	1	+	1	3	1	1	+	1	1	2	+	.	.	.
Brachypodium sylvaticum (Huds.) P.Beauv.	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carduus pycnocephalus L.	+	.	.	.	.	.	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex flacca Schreb. subsp. flacca	.	1	2	+	+	1	.	1	+	.	2	+	.	.	.	.	1	+	+	.	1	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex otrubae Podp.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex pendula Huds.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
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Centaurea jacea L. subsp. gaudinii (Boiss. & Reut.) Gremli	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Centranthus ruber (L.) DC. subsp. ruber	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.
Cephalanthera rubra (L.) Rich	.	.	.	.	.	.	.	.	.	.	+	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cervaria rivini Gaertn.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.	.
Chamaenerion dodonaei (Vill.) Schur ex Fuss	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cistus creticus L. subsp. eriocephalus (Viv.) Greuter & Burdet	+	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cistus salviifolius L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	.	.	.	.
Clematis flammula L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
Clematis vitalba L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	1	1	.	.	1	+	1	.	1	.	.	+	.	.	1	1	.	+	2	.	.
Convolvulus sepium L.	+	+	.	.	.	1	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Coriaria myrtifolia L.	4	3	3	4	3	3	4	4	4	3	3	4	4	3	4	3	2	3	4	4	4	3	3	3	3	3	2	3	3	4	5	3	4	3	1	2	2
Cornus mas L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cornus sanguinea L.	2	1	2	.	+	.	.	+	+	3	2	2	+	+	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	2	.	1	+	.
Crataegus monogyna Jacq.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	+	.	1	+	2	+	+	.	1	+	+	.	.	.	.	+	.	.	.	.	.
Cruciata glabra (L.) C.Bauhin ex Opiz	.	.	.	.	.	.	+	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Cytisophyllum sessilifolium (L.) O.Lang	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	3	3	2	2	+	1	2	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Cytisus hirsutus L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Cytisus villosus Pourr.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Dactylis glomerata L. subsp. hispanica (Roth) Nyman	.	.	.	.	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Dioscorea communis (L.) Caddick & Wilkin	.	.	2	+	.	+	.	.	.	.	2	1	2	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elymus repens (L.) Gould subsp. repens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Emerus major Mill.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	+	.	1	1	+	.	+	.	1	.	.	.	.	.
Equisetum ramosissimum Desf.	1	.	.	.	1	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Erica arborea L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	1	+	+	1	+	2	.	.	.	.
Eupatorium cannabinum L. subsp. cannabinum	2	.	.	3	3	2	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Euphorbia cyparissias L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	.	.	.	.	.
Fragaria vesca L. subsp. vesca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Frangula alnus Mill. subsp. alnus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fraxinus ornus L. subsp. ornus	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	1	+	+	+	2	+	1	1	1	.	1	1	1	1	2	.	2	.	.	.	.	.
Galega officinalis L.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Galium album Mill. subsp. album	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Galium lucidum All.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.
Galium mollugo L.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Genista pilosa L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	.	.	.	.	.	.	+	.	.	.	.	.
Hedera helix L. subsp. helix	1	+	2	3	1	1	+	.	+	.	.	2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+
Helleborus foetidus L. subsp. foetidus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helleborus odorus Waldst. & Kit.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hepatica nobilis Mill.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hippophaë fluviatilis (Soest) Rivas Mart.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Holcus lanatus L. subsp. lanatus	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus effusus L. subsp. effusus	.	.	.	.	.	.	.	.	.	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juniperus communis L.	.	.	+	2	1	2	+	+	2	.	.	+	2	.	.	.	2	2	2	.	1	+	1	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lathyrus latifolius L.	+	+	.	.	.	.	.	.	.	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lathyrus sylvestris L. subsp. sylvestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ligustrum vulgare L.	+	1	3	.	.	.	.	+	.	.	.	.	.	.	.	.	+	3	+	1	.	1	1	1	1	.	.	.	.	.	.	.	.	.	+	+	.
Limniris pseudacorus (L.) Fuss	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lonicera caprifolium L.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lonicera etrusca Santi	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	1	.	.	.	+	.	.	.	.	+	.	.	.	.
Lotus corniculatus L.	.	.	.	.	.	.	.	.	+	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lotus dorycnium L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Lotus hirsutus L.	.	.	1	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Lycopus europaeus L.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Malus sylvestris (L.) Mill.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Mentha aquatica L. subsp. aquatica	.	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Molinia coerulea (L.) Moench	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ostrya carpinifolia Scop.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	+	.	.	+	+	1	+	1	+	.	+	.	.	.	+	1	.	1	+	.

Osyris alba L.	.	+	2	1	1	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Picris hieracioides L. subsp. hieracioides	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Populus nigra L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Primula vulgaris Huds. subsp. vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Prunus avium (L.) L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.
Prunus spinosa L. subsp. spinosa	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	+	1	.	.	.	+	+	+	+	.	.	.	.	.	.	3	.	.	.	.	.
Pteridium aquilinum (L.) Kuhn subsp. aquilinum	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pulicaria dysenterica (L.) Bernh.	+	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pulmonaria officinalis L.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pyracantha coccinea M.Roem.	.	.	.	+	.	+	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pyrus communis L. subsp. pyraster (L.) Ehrh.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	1	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Quercus cerris L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	1	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Quercus ilex L. subsp. ilex	.	.	.	+	1	1	2	+	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quercus pubescens Willd. subsp. pubescens	.	.	+	1	.	+	+	.	+	.	.	.	1	.	.	.	.	.	.	.	.	1	1	1	.	+	+	+	+	+	.	1	.	.	.	.	.
Ranunculus repens L.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Reichardia picroides (L.) Roth	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhamnus alaternus L. subsp. alaternus	1	2	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	+	.	.	.	.	.	.
Robinia pseudoacacia L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rosa canina L.	.	+	3	.	.	.	.	.	.	.	.	.	.	.	1	1	+	+	1	+	+	+	+	.	+	.	.	.	.	.	.	1	.	.	.	.	.
Rosa sempervirens L.	.	.	.	.	.	.	.	1	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Rubia peregrina L.	+	.	1	1	+	+	+	1	2	1	.	+	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	2	2	1	.	.	2	.	.	.
Rubus species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Rubus ulmifolius Schott	1	.	2	.	.	.	.	.	.	2	3	2	.	.	.	+	.	+	.	.	+	.	.	.	+	+	.	.	+	+	1	2	2	1	3	3	5
Salix eleagnos Scop.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix purpurea L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scirpoides holoschoenus (L.) Soják	.	.	.	.	.	.	.	.	.	.	.	2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solidago virgaurea L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Spartium junceum L.	.	2	.	.	.	.	2	.	.	.	1	.	.	.	.	+	.	.	.	+	2	1	.	.	.	4	4	4	3	3	2	2	.	+	.	.	.
Stachys recta L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Teucrium chamaedrys L. subsp. chamaedrys	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.
Thymus vulgaris L. subsp. vulgaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Tommasinia altissima (Mill.) Reduron	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Tussilago farfara L.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Urospermum dalechampii (L.) F.W.Schmidt	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viburnum lantana L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viburnum tinus L. subsp. tinus	2	3	2	2	+	1	+	+	3	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vincetoxicum hirundinaria Medik. subsp. hirundinaria	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Viola alba Besser subsp. dehnhardtii (Ten.) W.Becker	+	+	.	+	.	+	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola reichenbachiana Jord. ex Boreau	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Appendix II - Additional data

Date and locality of the relevés

Tab. 1: San Leonino, Siena (Italy); 15 June 2018; 43.417308° N, 11.290733° E.

Sporadic species of the relevés

Tab. 1 - Rel. 1: Ranunculus repens L. +; rel. 2: Tussilago farfara L. +; rel. 5: Reichardia picroides (L.) Roth +; rel. 6: Carex otrubae Podp. +; rel. 7: Cruciata glabra (L.) C.Bauhin ex Opiz +, Carex otrubae Podp. +, Teucrium chamaedrys L. subsp. chamaedrys +; rel. 8: Pulmonaria officinalis L. 1; rel. 9: Ranunculus repens L. +, Tussilago farfaraL. +, Carex pendula Huds. +, Pteridium aquilinum (L.) Kuhn subsp. aquilinum +; rel. 10: Cruciata glabra (L.) C. Bauhin ex Opiz 1, Limniris pseudacorus (L.) Fuss +, Picris hieracioides L. subsp. hieracioides +; rel. 11: Urospermum dalechampii (L.) F.W. Schmidt +, Galega officinalis L. +, Galium album Mill. subsp. album +, Galium mollugo L. 2, Lycopus europaeus L. +; rel. 12: Limniris pseudacorus (L.) Fuss +, Scirpoides holoschoenus (L.) Soják 2, Urospermum dalechampii (L.) F.W. Schmidt +, Holcus lanatus L. subsp. lanatus 1; rel. 13: Scirpoides holoschoenus (L.) Soják +.

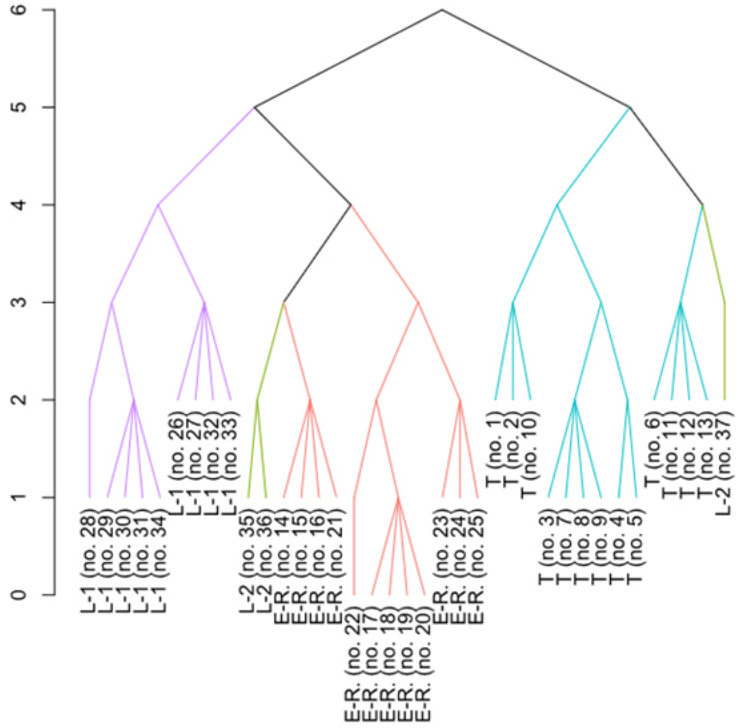

Fig. A - TWINSPAN results showing the clusters of our dataset. Colours correspond to different areas of Italy and are consistent with Fig. 3 of the main text.

Specimina visa of* Coriaria myrtifolia *L. in Italy. The parts in grey are doubtful or not deciphered

Emilia-Romagna: Flora alveale (Parma), Citerna 23 July 1919, *leg. et det.* M. Minio (FI052921); Flora alveale (Parma), Lesignano 23 July 1919, *leg. et det.* M. Minio (FI052922); Bologna, Monte S. Donato, 25 May, 1873, leg. Marchesettidet. R. Corradi (FI052923); nell'appennino Parmense presso Berceto donde discende lungo l'alveo del Taro, *s.d.*, *leg. et det.* G. Passerini (FI052924); Letto del torrente lungo la strada Ghiarre – Berceto (Appennino Parmense), 18 June 1908, *leg. et det.* P. Bolzon (FI052917). Friuli Venezia Giulia: Trieste – Chiadino (bosco di Pini), May 1896, *leg. et det.* C. Marchesetti (FI052918); Trieste St. Andrea, 21 April 1868, *leg. et det.* C. Marchesetti (FI052919); Chiadino, selvatichita, July 1871, *leg. et det.* C. Marchesetti (FI052920). Liguria: Alassio, via romana ad Albenga, 2 June 1927, *leg. et det.* Gresino (FI052901); Boschi di Lucinasco, 8 July 1929, *leg. et det.* R. Corradi (FI052902); Alla Mortola Ventimiglia scogli presso il mare, 10 September 1892, *leg. et det.* U. Martelli (FI052903); Prov. Imperia, Caravonica, 2 August 1942, *leg. et det.* R. Corradi (FI052904); San Lazzaro Reale (Prov. Imperia) nel fiume Impero presso Pagani, 3 August 1932, *leg. et det.* R. Corradi (FI052905); Remparts á l'est de Gênes, Italie, Août 1872, *leg. et det.* H. Groves (FI052906); Liguria occid. le presso le Grotte di Verzi (Loano), 21 May 1903, *leg. et det.* G. Doria (FI052907); Liguria occid., Bordighera, in colli bus apricis, aridis, usque-ad 700 m. alt. solo calcareo, 14 April and 16 May 1904, *leg. et det.* C. Bicknell et L. Pollini (FI052908); Liguria occid., Bordighera, November 1910, *leg. et det.* C. Bicknell (FI052909); Italia, Genovesato, April May 1863, *leg. et det.* Figari (FI052910); Capo delle Mele, Liguria occ., 1 June 1873, *leg. et det.* A. Piccone (FI052911); Spotorno, Liguria occ., 23 April 1867, *leg. et det.* A. Piccone (FI052912); Civezza vicino a Porto Maurizio, 18 February 1872, *leg. et det.* Ricca (FI052913); Genova, presso la Torrazza, 17 May 1896, *leg. et det.* G. Doria (FI052914); In silvae (Bosco di Pini), 1899, *leg. et det.* M. Spencer (FI052915); Aux alentours d'Evigno, à env. 14 km de Diano Marina, commune du littoral méditerranéen, à l'est d'Imperia (Italie, prov. Imperia, Ligurie), étage des collines, coteau sec, sur calcaire, May 1993, *leg. et det.*G. Van Buggenhout (FI052916); Val Bisagno alla Scoffera, 2 June 1959, *leg. et det.* R. Cucini (SIENA); Forte di Quezzi, April and May 1930, *leg. et det.* R. Cucini (SIENA); Bordighera, Liguria, 4 April 1840, *leg. et det.* C. Bicknell (RO); Nel greto del Bisagno, Genova, 20 August 1958 *leg. et det.* G. Lusina (RO); La mortola, Imperia, 11 May 1988, *leg. et det.* A. Gentile (GE); Bordighera, 13 May 1886, *leg. et det.* C. Bicknell (GE); Capo Mele, sotto il faro, Savona, Liguria occ., 6 March 1975, *leg. et det.* S. Peccenini (GE); Spotorno, Liguria occ., 23 April 1867, *leg. et det.* A. Piccone (TO); Capo delle Mele, Liguria occid., 1 June 1893, *leg. et det.* F. Negri (TO); Albenga, foce della Centa, Liguria di Ponente, 28 May 1892, *leg. et det.* Dott. Belli e Ferrari (TO); Colli di Genova, April 1863, *leg. et det.* XXX (TO); Badalucco (Imperia), salendo alla Madonna della Neve, boschi, 27 July 1957, *leg. et det.* Mondino, Ariello (TO); Neimonti a Diano Marina, Liguria occ., 20 July 1888, *leg. et det.* E. Ferrari (TO); Finale marina, nei dumeti sulla Capra-Zoppa, Liguria occ., August 1868, *leg. et det.* G. Gibelli (TO); Bordighera, Liguria occ, in collibus apricis, aridis, usque ad 700 m, solo calcareo, 14 April et 16 May 1904, *leg. et det.* C. Bicknell et L. Pollini (TO); Vendone, Savona, 400 m, 12 June 2001, *leg. et det.* Angelo Pareto (TO); Ceriale Panoramica, Savona, 150 m, 14 March 2001, *leg. et det.* Angelo Pareto (TO); Neipressi di Evigno in testa alla valle del torrente S. Pietro, Diano Marina, zona umida, bosco a *Quercus pubescens* e *Ostrya carpinifolia*), 15 July 1993, *leg. et det.* Siniscalco, Barni (TO); Valle d'Oneglia (frequente nelle selve), July 1894, *leg. et det.* Burnat et Gremli (TO); In rupibus coll. Prope Oneliam [Oneglia, Imperia, Liguria], 1816 *leg. et det. s.c.* (TO); In collibus genuensibus all'Oreggina [today Oregina, neighborhood of Genova], may 1855, *leg*. Gennari (TO); Ad sepesprope Finale, 10 XXX 1849, *leg. et det. s.c.* (TO). Toscana: Lago di San Leonino, Castellina in Chianti, Siena, 5 July 2019, *leg. et det.* G. Bonari (SIENA). Sicilia: In fruticetis maritimis an sponte? Palermo 1886, *leg. et det.* Lojacono (FI052925). Italia: Italia media e meridionale, *s.d.*, *leg. et det.* Covati (TO).

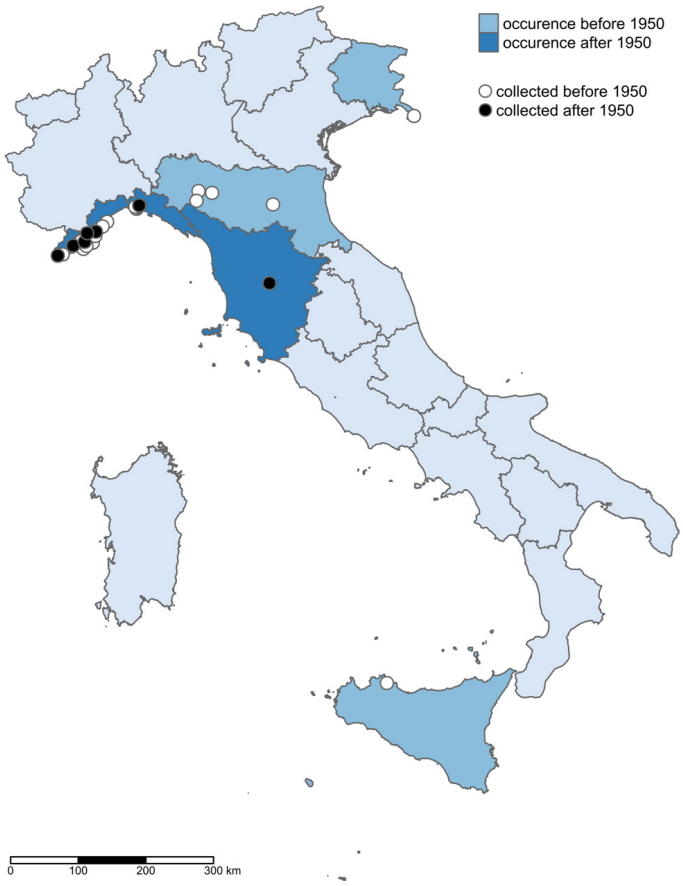

Fig. B - Map of the specimina visa of *Coriaria myrtifolia* in Italy retrieved in six Italian herbaria (FI, GE, MSU, RO, SIENA, TO). Data in the literature are not reported in the map.