A phytosociological survey of the Corynephorus canescens (L.) Beauv. communities of Italy

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Abstract
In Italy, Corynephorus communities are distributed along the medium course of the Ticino river and Sesia river and the internal sand dunes of Lomellina (through the Vercelli, Novara and Pavia provinces); these stations represent the southern limit of European distribution of this habitat. A phytosociological study was carried out to gain better knowledge of their composition; of their affinity or diversity against the central European communities; of their distribution and of the main threats to their conservation. Original and literature releves (114) were elaborated producing a cluster analysis; correspondence analysis (CA), principal component analysis and Kruskal–Wallis test were carried on to characterize the clusters of releves taking into consideration biological forms, chorological groups, Ellenberg indicator values and floristic groups. Italian Corynephorus communities can be attributed to the following syntaxa: Spergulo vernalis-Corynephoretum canescents, Spergulo vernalis-Corynephoretum canescents cladonietosum, Spergulo vernalis-Corynephoretum canescents silenetosum nutantis and Spergulo vernalis-Corynephoretum canescents artemisietosum campestris. Italian Corynephorus communities are included in the Habitat 2330 of the EU Habitat Directive. They are threatened by different factors (such as restricted areas of occurrence, alien plant invasion and natural dynamics) and they need to be managed if we want to conserve them.

Keywords: Acidic dry grasslands, dynamics, phytosociology, Po Plain, threats

Introduction
Corynephorus canescens has been variously interpreted as an Atlantic, sub-Atlantic, oceanic–suboceanic or European southern-temperate species (Marshall 1967; Preston et al. 2002; Danihelka 2010).

Its native distribution occupies most of European central and western lowlands, from Ukraine and Belarus in the east, through all countries bordering the southern Baltic, southern North Sea and the Atlantic Ocean as far as south Portugal (Blunt 2006). The Carpathians and Alps act as a general boundary to the species range extension in the south, with the exception of an outlying population in the Hungarian plain between the Danube and Tisza rivers (Rychnovská 1963). The C. canescens also reaches the French Mediterranean coast of Languedoc, but is absent from most of Spain except for a spur in central Castille. Outside this principal range, there are scattered coastal populations in southern Norway and Sweden; the Eastern Baltic as far north as Riga and in Romania and northern Marocco. Blunt (2006) describes its distribution in Poland. Within the British Isles, C. canescens is chiefly a plant of coastal dunes and tidal beaches; it is very local on and near coasts of Jersey, E and W Suffolk, E and W Norfolk, S Lancs, rare inland in E Suffolk, probably introduced on coasts of Moray, Westerness and E Lothian, and naturalized in Staffs and Worcs (Stace 2010).

Another outlying population is in Italy in the north-western part of the Po River Plain; observations were made by Bertossi (1950), Corbetta (1968) and Assini (2007) on the typical inland fossil dunes called “dossi” in the area of the Lomellina (Lombardy Region, Pavia Province).

Recently, C. canescens has been subjected to the IUCN (International Union for Conservation of Nature) assessment procedure (Assini & Abeli, in press) and new sites were recorded (Varese et al. 2010) along the Sesia river and the Ticino river...
(Piedmont Region). According to this assessment, the grey hair-grass status is endangered in Italy. Where present C. canescens often dominates dry acidic grasslands, which are a declining European habitat designated for conservation under the EU Habitat Directive (Habitat 2330 – Inland dunes with open Corynephorus and Agrostis grasslands and Habitat 2340* – Pannonic inland dunes). Italian Corynephorus communities are included in the Habitat 2330. In Germany C. canescens grasslands are currently more endangered than bogs or calcareous grasslands (Jentsch & Beyschlag 2003). Corynephorus communities are very rare and endangered in Italy; thus, a phytosociological study was carried out with the aim to classify and describe the Italian communities, gaining better knowledge of: their vascular species composition; similarity or dissimilarity from some Corynephorus syntaxa quoted in the main vegetation prodomes of central Europe; and distribution and main threats to their conservation.

**Materials and methods**

**Study sites**

The study area comprises almost all the sites where C. canescens is recorded in Italy; they are localized north of the Po river, in the west part of the Po Plain (Figure 1). Twenty-nine sites were studied (Supplement 1).

**Vegetation data**

The data for this study comprise original relevés and literature relevés. Thirty-four original phytosociological relevés (Pott 2011) were carried out during the spring–summer of 2009 using the Braun-Blanquet scale (1928). The size of the sampling plots was comprised between 5 and 15 m², and it is consistent with the plot sizes discussed by Chytry and Otýpková (2003) about low terrestrial vegetation and most types of herbaceous vegetation.

Italian literature relevés (25) derive from Assini (2007). We have also considered some European literature relevés (55) to analyse better the similarity or dissimilarity of Italian Corynephorus communities compared to the associations described for central Europe. We have considered the following relevés: Libbert 1933 (Corynephoretum typicum, Table XXI, rel. 2,4,6,9,12,14,15); Fischer 1960 (Corynephoretum canescentis Tx. 1937, Table 3, rel. 3,4,5,11,12,20,26, 27,30); Bidault 1961 (C. canescents, Table I, rel. 4,33,34,27); Krausch 1967 [(Spergulo vernalis-Corynephoretum (Tx. 1928) Libb. 1932, Table 7, rel. 1,2,3,6,7,8]); Korneck 1974 (Spergulo-Corynephoretum, Table 18, rel. 1,2,3,4,5,6,7,8); Krippel 1954 (C. canescens-Thymus angustifolius Assoziation, Table 2, rel. 1,3,6,9,10); Kosinová-Kucerová 1964 (Artemisia campestris-Corynephoretum canescents, rel. 1,2,6,15,16,18,20,25,26,27) and Krausch 1968 (Sileno-Festucetum Libbert 1933 Corynephorhus subass., Table 6, rel. 4,5,6, 17,18,1). We chose the relevés with the highest number of characteristic species described in the association table reported by each author because we considered them very representative of the cited syntaxa.

We only considered the cover-abundance of the lichen and moss strata in each relevés because no moss and lichen specialists were available while carrying out relevés. This is consistent with the fact that in our opinion and in literature the species of mosses and/or lichens do not play a basic role in the cluster analysis and in the syntaxonomical classification at association level. As stated by Bültmann (2005), together with bryophytes, lichens form syntaxonomically and often ecologically independent units, the microcoena. Furthermore, it is true that the lichen and moss composition is very important in the pioneer stages of the Spergulo-Corynephoretum and that such composition can change in relation to the habitat factors (according to Bültmann 2005, terricolous lichens and their microcommunities are sensitive indicators of microhabitat factors), but it also true that only species quantities change as response to

![Figure 1. Localization of the studied area.](image-url)
experimentally induced habitat changes, while the trends in vegetation changes are unidirectional, agreeing with the hypothetical series of the successional phases (Hasse & Daniëls 2006). According to Berg and Dengler (2005), only three moss species have diagnostic value at class and alliance levels in the Koelerio-Corynephoretea vegetation of Mecklenburg-Vorpommern, while many more lichen species have a diagnostic value for the same vegetation class. For this reason, lichen samples were carried out and classified in laboratory for a qualitative description of the lichen stratum of our Corynephorus communities.

**Species taxonomy and nomenclature**

Nomenclature of species which are present in Italy follows Conti et al. (2005); nomenclature of species which are present in Europe but not in Italy follows Flora Europaea (Tutin et al. 1964–1993). Nomenclature of syntaxa follows Mucina et al. (1993), Oberdorfer (1978) and Pott (1992). Nomenclature of lichens follows Nimis and Martellos (2008).

**Data analysis**

A table with a total number of 114 relevés was built. Because we considered only the cover of lichen and moss strata, for each European relevé the highest cover-abundance value showed by one species of lichen was attributed to the lichen stratum; if two or three lichen species showed the highest value, we increased the cover-abundance by one point. For example, if only one species of lichen showed the highest value of 2, we attributed this value to the lichen stratum; if two or three lichen species showed the highest value of 2, we assigned the value 3 to the lichen stratum. We did the same with moss species.

We did not include species with frequency of only 1–2 for analyses.

A matrix of 114 relevés × 102 species was elaborated using the SYN-TAX package (Podani 1993).

A cluster analysis was performed using quantitative values (combined transformation of Van der Maarel 1979), similarity ratio and average link (UPGMA – Unweighted Pair Group Method with Arithmetic Mean).

Ellenberg indicator values (Ellenberg et al. 1992), readapted by Pignatti (2005), were calculated for all relevés taking into account the cover values (weighted mean); mean values were used as variables in a principal component analysis (PCA) based on a variance–covariance matrix, in order to show the ecological difference among the surveys. The PCA was performed using the PAST package (Hammer et al. 2001).

Biological and chorological spectra, based on species frequency, were performed to compare the described vegetation types. Life forms and chorological elements for the species present in Italy follow Pignatti (2005) and Poldini (1991); life forms and chorological elements for the species not present in Italy follow Oberdorfer (2001).

Particularly, chorological elements were grouped in the following types: Wide distribution (including subcosmopolitan and cosmopolitan); European (including Europ-Westasiat, Europ-Caucas, Europ, Central-Europ, S-Central-Europ and W-Central-Europ); Subatlantic (including W-Europ and Subatl); Paleotemperate; Eurimediterranean; Eurimed-Subatlantic (including W-Eurimed, Eurimed-Atl, Eurimed-Subatl and NW-Med); Eurosia; Eurosibiric (including S-Europ-Southsib and Eurosib); Pont-Continental (including Eurimed-Pont, Euras-Cont, Euras-Cont-Smed, Europ-Cont and Cont-Smed); Aliens;
Circumboreal and Orophytes (including Oroph-S-Europ, Oroph-SW-Europe, Oroph-Europ and N-Med-Mont).

Kruskal–Wallis test was performed to test the significance among the values of the biological forms, chorological types and ecological factors of the identified cluster vegetation.

Correspondence analysis was performed on three matrices:

- a 5 × 8 matrix in which the eight vegetation clusters were described by the ratios between the total number of biological form occurrences in each cluster and the number of relevés in the cluster;
- a 11 × 8 matrix in which the eight vegetation clusters were described by the ratios between the total number of chorological type occurrences in each cluster and the number of relevés in the cluster; Aliens were excluded from this elaboration because they do not really reflect the phytogeography of the communities, but they can be interpreted as an effect of disturbance and human pressure;
- a 8 × 8 matrix in which the eight vegetation clusters were described by the ratios between the total number of species occurrences of each species group in each vegetation cluster and the number of relevés in each cluster (eight groups of species linked to the eight vegetation clusters have been identified taking into consideration both their syntaxonomical meaning in the previous literature and the differential role played in the analysed vegetation).

Kruskal–Wallis test and CA were performed by means of the PAST package (Hammer et al. 2001).

Results and discussion

Cluster analysis and syntaxonomy

Dendrogram resulted from cluster analysis (Supplement 2) showed eight clusters with nine relevés isolated and linked to them at low values of similarity; thus, they were considered atypical and excluded from the following syntaxonomical considerations.

The Spergulo vernalis-Corynephoretum canescentis silenotosum mutantis subass. nov. (Supplement 2, cluster 2, and Supplement 3, b) can be differentiated from the Spergulo vernalis-Corynephoretum cladonietosum by the presence of Silene nutans, Festuca stricta subsp. trachyphylla, Saponaria ocyoides, Hieracium piloselloides, Jasione montana, Peucedanum oreoselnum, Rubus caesius, and Koelera pyramidata. Lichens (C. foliacea, C. furcata, C. pixidata, Cladonia subcervicornis) and mosses are abundant. The relevés come from the Ticino river. The nomenclature type of this community is indicated in Appendix 1.

The Spergulo vernalis-Corynephoretum canescentis (Tx. 1928) Libbert 1933 (Supplement 2, cluster 3, and Supplement 3, c) differs from the Spergulo-Corynephoretum cladonietosum by the absence or the low cover-abundance of mosses and lichens, and it differs from the Spergulo vernalis-Corynephoretum silenotosum by the absence of its differential species. The table includes Italian relevés, coming from inland sand dunes and the Ticino river, and European relevés (Bourgogne, Marchfelde, Stechlinsee, Rheinpfalz). Lichens of Italian relevés include C. foliacea, C. furcata and Stereocaulon condensatum; lichens of European relevés include also Cladonia macilenta subsp. floerkeana, Cladonia pleurota and Cladonia coccifera. Chytry (2007) considers this association synonymous of Coryneculare aculeatae-Corynephoretum canescentis Steffen 1931.

The Spergulo vernalis-Corynephoretum festucetosum ovinae Fischer 1960 (Supplement 2, cluster 4, and Supplement 3, d) differs from the other Spergulo vernalis-Corynephoretum subassociations by the presence of Agrostis capillaris, Festuca ovina, Scleranthus perennis, J. montana, Pinus sylvestris and Helichrysum arenarium. Lichen (C. aculeata, C. macilenta subsp. floerkeana, C. pleurota, Cladonia cervicornis subsp. verticillata, C. rangiferina, C. arbuscula subsp. mitis, Cladonia gracilis) and moss cover-abundance is variable. The table includes only central European relevés from Neumark, Prignitz, steepleschloss.

The Spergulo vernalis-Corynephoretum artemisietosum campestris subass. nov. (Supplement 2, cluster 5, and Supplement 3, e) differs from the other Spergulo vernalis-Corynephoretum subassociations by the presence of T. pulegioides, Artemisia campestris, Centaurea deusta, H. nummularium, Cynodon dactylon and Hypericum perforatum. Lichens and mosses are absent.
This subassociation includes only Italian relevés coming from the Ticino river and the Sesia river. It differs from the Artemisio campestris-Corynephoretum Kosinová-Kučerová 1964 because of the absence of the characteristic species (S. perennis, Dianthus carthusianorum, Centaurea rhenana, Potentilla argentea, Trifolium arvense) and other species (F. ovina, Phleum phleoides, Achillea millefolium, Plantago lanceolata, Sedum acre, Sedum rupestre, Petrorhagia prolifera, Poa pratensis, Carlina vulgaris, Asperula cynanchica, Pimpinella saxifraga). The nomenclature type of this community is indicated in Appendix 1.

The Thymo angustifolii-Corynephoretum canescentis Krippel 1954 (Supplement 2, cluster 6, and Supplement 3, f) described for the Slovak part of the Marchfeldes and recorded in the Marchvalley in Austria, is considered a geographical vicarious of the Spergulo-Corynephoretum (Mucina et al. 1993). Characteristics species are Thymus serpyllum subsp. angustifolius, Euphorbia seguierana, J. montana and Veronica verna. Lichens (C. aculeata, Cladonia sp.) and mosses are sporadic. Chytry (2007) considers also this association synonymous of Cornuculario aculeatae-Corynephoretum canescentis Steffen 1931.

The Artemisio campestris-Corynephoretum canescentis Kosinová-Kučerová 1964 (Supplement 2, cluster 7, and Supplement 3, g), described by Kosinová-Kučerová (1964) for the Middle Vltava (central Bohemia), comprises acidophytic steppes. Lichens (Cetraria islandica, C. aculeata, Cladonia sp., Peltigera canina) and mosses are sporadic. Characteristic species of the association are A. campestris, T. pulegioides, S. perennis, J. montana, D. carthusianorum, C. rhenana, P. argentea and T. arvense. The systematic position of this association within the Festuco-Sedetalia order Tüxen 1951 em. Krausch 1962 is not clear.

The Armerio-Festucetum trachyphyllae (Libbert 1933) Knapp 1948 ex Hohenester 1960 C. canescens subass. (Supplement 2, cluster 8, and Supplement 3, h) was described by Krausch (1968) for the Brandenburg dry grasses. Pott (1992) reported the association only in Mecklenburg. Lichens (C. arbuscula subsp. mitis, C. foliacea) and mosses are sporadic. Characteristics and differential species of association are Silene oites, Festuca trachyphylla, D. carthusianorum, C. rhenana, Chondrilla juncea, P. phleoides, Pseudolysimachion spicatum and P. oreoselinum. Differential species of subassociation is C. canescens.

Environmental conditions

Figure 2 shows the PCA results. Temperature resulted highly correlated with the first component, while R resulted highly correlated with the second component. Cluster 1 (Spergulo-Corynephoretum cladonietosum) and
Cluster 3 (Spergulo-Corynephoretum) seem to be ecologically more heterogeneous than the other clusters (with Cluster 3 which is a little bit more thermophilous than Cluster 1), while Cluster 2 (Spergulo-Corynephoretum artemisietosum), Cluster 4 (Spergulo-Corynephoretum festucetosum), Cluster 5 (Spergulo-Corynephoretum artemisietosum), Cluster 6 (Thymo-Corynephoretum), Cluster 7 (Artemisio-Corynephoretum) and Cluster 8 (Armerio-Festucetum Corynephoreus subass.) seem ecologically better distinguishable. Cluster 7 and Cluster 4 are less thermophilous than the other clusters, with Cluster 6 which is the most thermophilous. Cluster 4 and Cluster 6 are more acidic than the other clusters, with Cluster 7 and Cluster 8 which are the less acidic.

Biological and chorological spectra

Figure 3 shows the life forms (expressed as percentage data) in the different Corynephorus communities. Particularly, Spergulo-Corynephoretum is the richest in Therophytes (almost 50%), while Armerio-Festucetum Corynephoretum subass. and Artemisio-Corynephoretum are the richest in Hemicyryptophytes (more than 70%) and the poorest in Therophytes (less than 10%), with a discrete presence of Chamaephytes (comprised between 10% and 20%). The Therophyte percentage in the other communities is comprised between 20 and 30, while the Hemicyryptophytes percentage is comprised between 50 and 70, with the exception of Thymo-Corynephoretum which shows a Hemicyryptophyte percentage lower than 40, but the highest percentage of Geophytes (15). In this last community as in Spergulo-Corynephoretum artemisietosum, the Chamaephyte percentage is discrete (more than 15). In all Corynephorus communities Nanophytes and Phanerophytes are scarce, with percentage generally lower than 5.

Table I shows the chorological elements (expressed as percentage data) in the different Corynephorus communities. Spergulo-Corynephoretum and Spergulo-Corynephoretum cladonietosum (which include Italian and European relevés) are characterized by a good presence of Wide distribution, European and Subatlantic elements; also the Eurimed-Subatlantic elements show a discrete presence. Spergulo-Corynephoretum silenetosum and Spergulo-Corynephoretum artemisietosum (which include only Italian relevés) are characterized by a good presence of Eurimediterannean and Eurimed-Subatlantic elements, while the presence of Eurosibiric and Pont-Continental elements is very low; also, the presence of Eurasiatic is scarce. On the contrary, Spergulo-Corynephoretum festucetosum, Thymo-Corynephoretum, Artemisio-Corynephoretum and Armerio-Festucetum Corynephoreus subass. (which include only European relevés) show a discrete presence of Eurimeditterannean and Eurimed-Subatlantic elements and a good presence of Eurosibiric, Eurosiatic and Pont-Continental elements.

If we consider only the two Italian communities, we can observe that Spergulo-Corynephoretum artemisietosum is very rich in Aliens and show a higher percentage of Circumboreal elements than Spergulo-Corynephoretum silenetosum. This last community is characterized by a high percentage of Orophytes (10).

Kruskal–Wallis test

In Table II, the results of the test are reported. Almost all the considered variables are significant in
Table II. Results of the Kruskal-Wallis test.

| Variables                        | Significance |
|----------------------------------|--------------|
| Biological forms                 | n.s.         |
| Therophytes                      | p < 0.001    |
| Hemicryptophytes                 | p < 0.001    |
| Geophytes                        | p < 0.05     |
| Chamaephytes                     | p < 0.001    |
| Nanophanerophytes/Phanerophytes  | n.s.         |
| Chorological types               |              |
| Wide distribution                | p < 0.001    |
| European                         | p < 0.001    |
| Subatlantic                      | n.s.         |
| Paleotemperate                   | p < 0.001    |
| Eurimediterranean                | p < 0.001    |
| Eurimed-Subatlantic              | p < 0.001    |
| Eurasian                         | p < 0.001    |
| Eurosibiric                      | p < 0.001    |
| Pont-Continental                 | p < 0.001    |
| Aliens                           | p < 0.05     |
| Circumboreal                     | p < 0.001    |
| Orophytes                        | p < 0.05     |
| Ecological factors               |              |
| Soil reaction                    | p < 0.001    |
| Temperature                      | p < 0.001    |
| Continentality                   | p < 0.001    |
| Moisture                         | p < 0.001    |
| Nitrogen                         | p < 0.001    |
| Light                            | p < 0.05     |

determining the variability between the cluster vegetation and confirm the differences between them. Only the Terophyte and Nanophanerophyte/Phanerophyte biological forms and the Subatlantic chorological type are not significant.

**Correspondence analysis**

Figure 4 shows the CA results from biological forms and vegetation clusters matrix; it points out the linkage between biological forms and vegetation clusters, with: *Thymo-Corynephoretum* (6) particularly characterized by the Geophytes; *Artemisio-Corynephoretum* (7) and *Armerio-Festucetum Corynephorus* subass. (8) particularly characterized by the Chamaephytes; *Spergulo-Corynephoretum artemisietosum* (5) and *Spergulo-Corynephoretum silenetosum* (2) particularly characterized by the Hemicryptophytes; and *Spergulo-Corynephoretum* (3) particularly characterized by *Spergulo-Corynephoretum cladonietosum* (1) and *Spergulo-Corynephoretum festucetosum* (4) are characterized by both the Terophytes and the Hemicryptophytes.

Figure 4 also gives suggestions for the interpretation of the dynamic processes in which *C. canescens* communities are involved. The most pioneer community (*Spergulo-Corynephoretum*) is placed on the right of the plot; the most evolved communities, both from central Europe (*Armerio-Festucetum Corynephorus* subass. and *Artemisio campestris-Corynephoretum canescensis*) and from Italy (*Spergulo-Corynephoretum artemisietosum* and *Spergulo-Corynephoretum silenetosum*), are placed on the left. *Spergulo-Corynephoretum festucetosum, Spergulo-Corynephoretum cladonietosum* and *Thymo-Corynephoretum* are placed among the most pioneer community and the most evolved ones.

Figure 5 shows the CA results from chorological types and vegetation clusters matrix; it points out the linkage between chorological types and vegetation clusters, with: *Artemisio-Corynephoretum* (7) and *Armerio-Festucetum Corynephorus* subass. (8) particularly characterized by Circumboreal, Eurosibiric and Pontic-Continental; *Thymo-Corynephoretum* (6) particularly characterized by Eurasian and European; *Spergulo-Corynephoretum artemisietosum* (5) particularly characterized by Paleotemperate and Eurimediterranean; *Spergulo-Corynephoretum silenetosum* (2) particularly characterized by Paleotemperate, Eurimediterranean and Orophytes; and *Spergulo-Corynephoretum* (3) particularly characterized by Eurimed-Subatlantic. *Spergulo-Corynephoretum cladonietosum* (1) and *Spergulo-Corynephoretum festucetosum* (4) result more heterogeneous without a particular chorological type characterizing them.

Figure 6 shows the CA results from species groups and vegetation clusters matrix; it points out the linkage between species groups and vegetation clusters and also gives suggestions about the interpretation of the dynamic processes in which *C. canescens* communities are involved. The pioneer communities (*Spergulo-Corynephoretum, Spergulo-Corynephoretum cladonietosum*) and their differential species groups are placed on the right of the plot; the most evolved communities, both from Italy (*Spergulo-Corynephoretum artemisietosum*) and from central Europe (*Armerio-Festucetum trachyphyllae, Artemisio campestris-Corynephoretum canescensis*), are placed on the left together with their differential species. *Spergulo-Corynephoretum silenetosum, Spergulo-Corynephoretum festucetosum* and *Thymo-Corynephoretum* are placed among the pioneer and the most evolved communities.

Table III shows the synoptic table of *Corynephorus* communities, indicating the percentage presence of the different species groups in the vegetation clusters.

**Dynamics interpretation of the Italian Corynephorus communities**

The successional trajectories for plant communities of acidic grasslands mainly depend on climatic conditions, soil pH, water and nutrient availability, disturbance regimes, and nearby seed pools (Jentsch & Beyschlag 2003). Stability and successional behaviour of plant communities on inland sand dunes are insufficiently known (Jentsch & Beyschlag
Ecological factors both from central Europe (right of the plot; the most evolved communities, community (4) are characterized by both the Terophytes and the Hemicryptophytes. Spergulo-Corynephoretum particularly characterized by the Terophytes. Spergulo-Corynephoretum silenetosum (5) and Armerio-Festucetum Corynephorus subass. (8) particularly characterized by the Chamaephytes; and Spergulo-Corynephoretum artemisietosum (3) particularly characterized by Eurimediterranean and Orophytes; and Spergulo-Corynephoretum festucetosum (7) and Artemisio-Corynephoretum particularly characterized by Paleotemperate, Eurasian, and Eurasiatic. Table III shows the synoptic table of chorological type characterizing them.

Figure 4 also gives suggestions for the interpretation of the dynamic processes in which the vegetation clusters and also gives suggestions about the interpretation of the dynamic processes in which the vegetation clusters matrix; it points out the linkages between biological forms and vegetation groups. Figure 5 shows the CA results from biological forms and the Subatlantic determining the variability between the cluster results more heterogeneous without a particular context.

| Light | Nitrogen | Moisture | Continentality | Orophytes | Circumboreals | Pont-Continental | Eurosibiric | Eurasiatic | Eurimediterranean | Paleotemperate | Subatlantic | Wide distribution |
|-------|----------|----------|----------------|------------|---------------|-----------------|-------------|------------|---------------------|-----------------|--------------|------------------|
| 1     | 0.001    | 0.001    | 0.05           | 0.05       | 0.05          | 0.05            | 0.05        | 0.05       | 0.05                | 0.05            | 0.05         | 0.05             |
| 2     | 0.001    | 0.001    | 0.05           | 0.05       | 0.05          | 0.05            | 0.05        | 0.05       | 0.05                | 0.05            | 0.05         | 0.05             |
| 3     | 0.001    | 0.001    | 0.05           | 0.05       | 0.05          | 0.05            | 0.05        | 0.05       | 0.05                | 0.05            | 0.05         | 0.05             |
| 4     | 0.001    | 0.001    | 0.05           | 0.05       | 0.05          | 0.05            | 0.05        | 0.05       | 0.05                | 0.05            | 0.05         | 0.05             |
| 5     | 0.001    | 0.001    | 0.05           | 0.05       | 0.05          | 0.05            | 0.05        | 0.05       | 0.05                | 0.05            | 0.05         | 0.05             |
| 6     | 0.001    | 0.001    | 0.05           | 0.05       | 0.05          | 0.05            | 0.05        | 0.05       | 0.05                | 0.05            | 0.05         | 0.05             |
| 7     | 0.001    | 0.001    | 0.05           | 0.05       | 0.05          | 0.05            | 0.05        | 0.05       | 0.05                | 0.05            | 0.05         | 0.05             |
| 8     | 0.001    | 0.001    | 0.05           | 0.05       | 0.05          | 0.05            | 0.05        | 0.05       | 0.05                | 0.05            | 0.05         | 0.05             |

Figure 5. CA biplot of vegetation clusters and chorological types. ADI, Wide distribution; CIR, Circumboreal; EAS, Eurasian; EMA, Eurimediterranean; EME, Eurasian; EUR, European; EUS, Eurosibiric; ORO, Orophytes; PAL, Paleotemperate; POC, Pont-Continental; SAT, Subatlantian. 1, Spergulo-Corynephoretum cladonietosum; 2, Spergulo-Corynephoretum silenetosum; 3, Spergulo-Corynephoretum artemisietosum; 4, Spergulo-Corynephoretum festucetosum; 5, Spergulo-Corynephoretum artemisietosum; 6, Thymo-Corynephoretum; 7, Artemisio-Corynephoretum; 8, Armerio-Festucetum Corynephorus subass.

Figure 6 shows the CA results from species groups placed among the pioneer and the most evolved communities, both from Italy (4) and the left together with their differential species.
Anyway, on the bases of the biological forms and floristic composition of the Italian communities, we can give a description of successional stages observed in Italy (Figure 7). Initially, the bare sand substrate is loosely covered by pioneer species such as *C. canescens*, *Teesdalia nudicaulis*, *Rumex acetosella* or *Filago minima* (*Spergulo vernalis-Corynephoretum canescentis*). These pioneers begin to fix the sand. As soon as the surface is consolidated, mosses and lichens, mainly of the genus *Cladonia*, may form a crust (*Spergulo vernalis-Corynephoretum canescentis cladonietosum*). In this stage, small soil disturbances (trampling, animals or others) provide open patches with bare substrate, which seem crucial for further seedling establishment of phanerogams (Jentsch & Beyschlag 2003). Moss and lichen dominated stages can exhibit long-term dynamic stability if site conditions remain constant. In case of more favourable water and nutrient conditions, *H. piloselloides*, *J. montana*, *S. otites*, *F. stricta* subsp. *trachyphylla*, *S. ocymoides*, *T. pulegioides* and *A. campestris* slowly become part of the community, forming mature stages (*Spergulo vernalis-Corynephoretum canescentis silenetosum* and *Spergulo vernalis-Corynephoretum canescentis artemisietosum*). In these stages, small soil disturbances can provide open patches with bare substrate. Typically, a mosaic of various successional stages is reached, which can remain relatively stable as long as soil nutrient content does not increase and disturbance frequency does not decrease.

If, on the contrary, soil nutrient content increases or disturbance frequency decreases, subsequent ruderal grasslands often dominated by alien plants (*Erigeron canadensis*, *Erigeron annuus*, *Oenothera* sp., *Ambrosia artemisiifolia*) or thermophilous grasslands often dominated by *F. stricta* subsp. *trachyphylla* (Lonati & Lonati 2007) may develop. Without human influence, these stages would change into shrubland and woodland.

**Conspectus of the syntaxa**

**KOELERIO-CORYNEPHORETEA** Klika in Klika et Nowak 1941

**CORYNEPHORETALIA CANESCENTIS** Klika 1934

*Corynephorion canescentis* Klika 1931

*Spergulo vernalis-Corynephoretum canescentis* (R. Tx. 1928) Libbert 1933

*Spergulo vernalis-Corynephoretum canescentis* (R. Tx. 1928) Libbert 1933 *cladonietosum* Tüxen 1937

*Spergulo vernalis-Corynephoretum canescentis* (R. Tx. 1928) Libbert 1933 *silenetosum nutantis* subass. nov.

*Spergulo vernalis-Corynephoretum canescentis* (R. Tx. 1928) Libbert 1933 *festucetosum ovinae* Fischer 1960

*Spergulo vernalis-Corynephoretum canescentis* (R. Tx. 1928) Libbert 1933 *artemisietosum campestris* subass. nov.
able water and nutrient conditions, conditions remain constant. In case of more favour-
can exhibit long-term dynamic stability if site
Beyschlag 2003). Moss and lichen dominated stages
seedling establishment of phanerogams (Jentsch &
with bare substrate, which seem crucial for further
cladonietosum
Spergulo vernalis-Corynephoretum canescentis
soon as the surface is consolidated, mosses and
(claytonia)
Spergulo vernalis-Corynephoretum ca-
sescentis artemisietosum
S. otites
Spergulo vernalis-Corynephoretum canescentis
T. pulegioides
Tu¨ xen 1937
Spergulo vernalis-Corynephoretum canescentis
S. Assini et al.
Table III. Synoptic table of the Corynephorus communities: data percentage.

| Group | Community | CLU1 | CLU2 | CLU3 | CLU4 | CLU5 | CLU6 | CLU7 | CLU8 |
|-------|------------|------|------|------|------|------|------|------|------|
| GROUP Ib (LowCoverLichenGroup) | Lichens | 73% | 57% | 81% | 26% | 0 | 20% | 80% | 50% |
| | Mosses | 45% | 86% | 8% | 47% | 0 | 20% | 100% | 33% |
| GROUP Ia (HighCoverLichenGroup) | Lichens | 27% | 14% | 15% | 16% | 0 | 0 | 0 | 0 |
| | Mosses | 55% | 0 | 0 | 11% | 0 | 0 | 0 | 33% |
| GROUP II (Silene-nutansGroup) | S. nutans L. | 0 | 86% | 0 | 0 | 0 | 0 | 0 | 0 |
| | F. stricta Host subsp. | 9% | 71% | 0 | 0 | 18% | 0 | 0 | 100% |
| | tachyphylla (Hack.) | | | | | | | | |
| | Patzke ex Pils | | | | | | | | |
| | H. piloselloides Vill. | 0 | 71% | 0 | 0 | 9% | 0 | 0 | 0 |
| | R. caesius L. | 0 | 57% | 4% | 0 | 27% | 0 | 0 | 17% |
| | S. ocymoides L. | 0 | 43% | 0 | 0 | 0 | 0 | 0 | 0 |
| | F. ovina L. | 0 | 43% | 4% | 63% | 0 | 40% | 100% | 33% |
| | P. orsellum (L.) Moench | 0 | 43% | 0 | 0 | 0 | 0 | 0 | 0 |
| | K. pyramidata (Lam.) | 0 | 43% | 0 | 0 | 0 | 0 | 0 | 0 |
| | Domin | | | | | | | | |
| GROUP III (Festuca-ovinaGroup) | A. capillaris L. | 9% | 0 | 0 | 95% | 0 | 0 | 30% | 50% |
| | H. arenarium (L.) Moench | 0 | 43% | 4% | 63% | 0 | 40% | 100% | 33% |
| | F. ovina L. | 0 | 0 | 0 | 53% | 0 | 0 | 90% | 0 |
| | P. sylvestris (L.) (BA) | 18% | 0 | 0 | 47% | 0 | 0 | 0 | 0 |
| | H. nummularium (L.) Miller | 0 | 43% | 0 | 0 | 0 | 0 | 0 | 0 |
| | J. montana L. | 0 | 43% | 0 | 0 | 18% | 0 | 0 | 100% |
| | S. perennis L. | 0 | 43% | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | |
| GROUP IV (Centaurea-deustaGroup) | A. campestris L. | 0 | 0 | 0 | 32% | 0 | 55% | 20% | 100% |
| | H. perforatum L. | 5% | 29% | 0 | 0 | 45% | 0 | 0 | 0 |
| | C. dausta Ten. | 9% | 29% | 12% | 5% | 45% | 0 | 0 | 50% |
| | H. nummularium (L.) Miller | 5% | 0 | 0 | 0 | 36% | 60% | 0 | 0 |
| | C. maculatum (L.) Pers. | 18% | 0 | 0 | 0 | 27% | 0 | 90% | 0 |
| | T. pulegioides L. | 18% | 0 | 0 | 0 | 27% | 0 | 20% | 0 |
| | T. serpyllum | 18% | 0 | 0 | 0 | 27% | 0 | 20% | 0 |
| GROUP V (Thymus-angustifoliusGroup) | T. serpyllum subsp. | 0 | 0 | 0 | 0 | 0 | 80% | 0 | 0 |
| | angustifolius (Pers.) | | | | | | | | |

(Continued)
Table III. (continued)

|                      | CLU1 | CLU2 | CLU3 | CLU4 | CLU5 | CLU6 | CLU7 | CLU8 |
|----------------------|------|------|------|------|------|------|------|------|
| **CLU1**             | Spergulo- | Spergulo- | Spergulo- | Spergulo- | Thymo- | Artemisio- | Arno- |
| Corynephoretum      | Corynephoretum | Corynephoretum | Corynephoretum | Corynephoretum | Corynephoretum | Corynephoretum | Festucetum | Festucetum |
| cladonietosum       | 22 rel | 26 rel | 19 rel | 11 rel | 5 rel | 10 rel | 6 rel | 7 rel |
| **CLU2**             | CLU3  | CLU4  | CLU5  | CLU6  | CLU7  | CLU8  |      |      |
| Spergulo-           | Corynephoretum | silenetosum | festucetosum | artemisietosum | Festucetum | Festucetum | Festucetum | Festucetum |
| **CLU3**             | 7 rel  | 26 rel | 19 rel | 11 rel | 5 rel | 10 rel | 6 rel | 7 rel |
| Spergulo-           | Corynephoretum | silenetosum | festucetosum | artemisietosum | Festucetum | Festucetum | Festucetum | Festucetum |
| **CLU4**             | 22 rel | 26 rel | 19 rel | 11 rel | 5 rel | 10 rel | 6 rel | 7 rel |
| **CLU5**             | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| **CLU6**             | 40%    | 40%    | 40%    | 40%    | 40%    | 40%    | 40%    | 40%    |
| **CLU7**             | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
| **CLU8**             | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |

**GROUP5 (Artemisia-campestris Group)**

|                      | CLU1 | CLU2 | CLU3 | CLU4 | CLU5 | CLU6 | CLU7 | CLU8 |
|----------------------|------|------|------|------|------|------|------|------|
| Euphorbia seguirianna Neck. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| V. verna L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| J. montana L. | 0    | 43%  | 4%   | 63%  | 0    | 0    | 0    | 0    |
| T. serpyllum L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |

**GROUP6 (Artemisia-campestris Group)**

|                      | CLU1 | CLU2 | CLU3 | CLU4 | CLU5 | CLU6 | CLU7 | CLU8 |
|----------------------|------|------|------|------|------|------|------|------|
| Euphorbia seguirianna Neck. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| V. verna L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| J. montana L. | 0    | 43%  | 4%   | 63%  | 0    | 0    | 0    | 0    |
| T. serpyllum L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |

**GROUP7 (Festuca-trachyphylla Group)**

|                      | CLU1 | CLU2 | CLU3 | CLU4 | CLU5 | CLU6 | CLU7 | CLU8 |
|----------------------|------|------|------|------|------|------|------|------|
| Euphorbia seguirianna Neck. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| V. verna L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| J. montana L. | 0    | 43%  | 4%   | 63%  | 0    | 0    | 0    | 0    |
| T. serpyllum L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |

**GROUP8 (Festuca-trachyphylla Group)**

|                      | CLU1 | CLU2 | CLU3 | CLU4 | CLU5 | CLU6 | CLU7 | CLU8 |
|----------------------|------|------|------|------|------|------|------|------|
| Euphorbia seguirianna Neck. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| V. verna L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| J. montana L. | 0    | 43%  | 4%   | 63%  | 0    | 0    | 0    | 0    |
| T. serpyllum L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |

**GROUP9 (Festuca-trachyphylla Group)**

|                      | CLU1 | CLU2 | CLU3 | CLU4 | CLU5 | CLU6 | CLU7 | CLU8 |
|----------------------|------|------|------|------|------|------|------|------|
| Euphorbia seguirianna Neck. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| V. verna L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| J. montana L. | 0    | 43%  | 4%   | 63%  | 0    | 0    | 0    | 0    |
| T. serpyllum L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |

**GROUP10 (Festuca-trachyphylla Group)**

|                      | CLU1 | CLU2 | CLU3 | CLU4 | CLU5 | CLU6 | CLU7 | CLU8 |
|----------------------|------|------|------|------|------|------|------|------|
| Euphorbia seguirianna Neck. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| V. verna L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| J. montana L. | 0    | 43%  | 4%   | 63%  | 0    | 0    | 0    | 0    |
| T. serpyllum L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |

**GROUP11 (Festuca-trachyphylla Group)**

|                      | CLU1 | CLU2 | CLU3 | CLU4 | CLU5 | CLU6 | CLU7 | CLU8 |
|----------------------|------|------|------|------|------|------|------|------|
| Euphorbia seguirianna Neck. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| V. verna L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| J. montana L. | 0    | 43%  | 4%   | 63%  | 0    | 0    | 0    | 0    |
| T. serpyllum L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |

**GROUP12 (Festuca-trachyphylla Group)**

|                      | CLU1 | CLU2 | CLU3 | CLU4 | CLU5 | CLU6 | CLU7 | CLU8 |
|----------------------|------|------|------|------|------|------|------|------|
| Euphorbia seguirianna Neck. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| V. verna L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
| J. montana L. | 0    | 43%  | 4%   | 63%  | 0    | 0    | 0    | 0    |
| T. serpyllum L. | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |
Thymo angustifolii-Corynephoretum canescensis
Krippel 1954
FESTUCO-SEDETALIA R. Tx. 1951 em. Krausch 1962
Artemisio campestris-Corynephoretum canescensis
Kosinová-Kučerová 1964
Plantaginí-Festucion ovinae Passarge 1964
Armerio-Festucetum trachyphyllae (Libbert 1933) Knapp 1948 ex Hohenester 1960 (=Sileno oitae-Festucetum Libbert 1933)
C. canescens subass.

Threats to Corynephorus communities
As stated by Janišova et al. (2011), while in some cases dry grasslands are directly destroyed by building activities or mining, the more serious threats are those affecting vast areas, namely agricultural intensification, land abandonment and atmospheric nitrogen input.

At local level, conservation and protection of Italian Corynephorus communities present different problems. Only places along the Ticino river and the Sesia river (Greggio) are included in protected areas (respectively, Ticino Park and Sesia Park). However, because of the insufficient knowledge, their management and monitoring have never been considered; thus, these communities are abandoned to succession.

In many areas, the principal factors that threaten their conservation are different. The surface area occupied by the community is often very limited (<20 m²). In many sites, the typical floristic composition is threatened by alien plant invasion. Different plants are involved in different sites: along the medium–low course of the Sesia, Eragrostis curvula (Schrad.) Nees is often abundant; in many sites, Robinia pseudoacacia, Ailanthus altissima and Prunus serotina threaten Corynephorus communities because of the shade produced by their canopies; and in other places, Reynoutria japonica, E. canadensis, E. annua and Oenothera sp. pl. are often present.

In all these cases, the establishment of forests with which Corynephorus communities can be in contact and the natural dynamics of the Corynephorus communities threaten Corynephorus communities if there is no management action.

The presence of allochtonous fauna could also be a problem, and this needs to be better studied. In many Italian sites, Sylvilagus floridanus (Allen 1890) is abundant and replaces the native wild rabbit. According to Jentsch et al. (2002), wild rabbit represents an important factor in the persistence of Corynephorus communities because of the disturbance from digging galleries. The same is still not demonstrated for Sylvilagus which shows more reduced disturbance activity and population explosions producing faeces accumulations that could increase soil nutrient availability and thus accelerate natural vegetation dynamic.

Conclusions
The Italian stations represent the extreme southern border of European distribution of Corynephorus communities, and this is the reason for which Italian communities lack typical central European species (such as Spergula morisonii, Mibora minima, Carex arenaria and H. arenarium) and can be differentiated by unique species combinations.

Italian Corynephorus communities can be attributed to the following syntaxa: Spergulo vernalis-Corynephoretum canescensis, Spergulo vernalis-Corynephorus nitens-Corynephoretum canescens subass.
phoretum canescens cladonietosum, Spergulo vernalis-Corynephoretum canescens silenietosum mutantis and Spergulo vernalis-Corynephoretum canescens artemisietosum campestris. The first two communities represent pioneer stages, while the last two ones represent more mature stages. Particularly Spergulo-Corynephoretum silenietosum and Spergulo-Corynephoretum artemisietosum seem to be exclusive of Northern Italy and are more rich of thermophilous elements than the most part of European communities; as seen before they are well distinguishable chorologically and ecologically.

Between the analysed European communities, the interpretation of Thymo angustifolii-Corynephoretum is not clear and should be studied in depth: Mucina et al. (1993) consider the association a geographical vicarious of the Spergulo-Corynephoretum, while Chytrý (2007) considers it as synonymous of the Spergulo-Corynephoretum. Our results show this association to be different from the Spergulo-Corynephoretum on the basis of the biological forms and chorological elements; it also results well distinguishable ecologically.

Italian Corynephorus communities, as the other dry acidic grasslands of Europe, need to be managed if we want to conserve them.

Literature references dedicated to the management and conservation of the Festuco-Brometea dry grasslands are numerous (just recently Hegedušová & Senko 2011; Janišová et al. 2011; Vassilev et al. 2011), while those dedicated to the management of the Koelerio-Corynephoretea grasslands are scarce.

Anyway, suggested management actions for Italian Corynephorus communities should include: a small-scale mechanical ground disturbance, the enhancement of Corynephorus populations and the invasive plant control.

As stated by Jentsch (2004), mechanical soil disturbances may cause mobility and redistribution of soil nutrients and induce germination of seeds stored in the soil seed bank. Small-scale soil disturbances also create bare sandy substrates and provide safe sites for novel seedling establishment in otherwise closed vegetation with high proportions of cryptogams; they especially maintain a niche for short-lived species and permit continual, low-density recruitment of perennials. For these reasons, we are experimenting a mechanical ground disturbance consisting in a ploughing of the upper soil layer (first 5 cm) with removal of the cryptogam crust in five plots at Cernago (PV), comparing them with five plots not disturbed. The experiment begun in 2009, but a long-term monitoring (almost for 6–10 years) will be necessary before having interesting results.

In 2005, we have also introduced C. canescens in a Nature 2000 site (TT2080008, Boschetto di ScaldaSOLE, Lombardy region, Pavia province) which is a remnant of an inland sand dune where the grey hair-grass was not present. We are monitoring the plant, but also in this case a long-term monitoring will be necessary to test the efficiency of our introduction.

About the invasive plant control, we have not experiments/works in progress, but we think that the control of almost the invasive woody individuals (particularly of the following species: Robinia pseudoacacia, P. serotina, A. altissima) should be possible by means of punctual treatments, also chemical, in Corynephorus communities where invasive trees are still sporadic and scattered. Chemical treatments are of course not suggested where the density of invasive plants is high.

Also for the control of invasive herbaceous species, we have no works in progress, but we think that studies on the ecology and functional traits (Ordonez et al. 2010) of invasive herb plants should be realized to better understand their invasion success.

Furthermore, the knowledge level of lichens and mosses (dynamism, ecology and conservation value) should also be increased for better suggestions about the conservation and restoration of the Italian Corynephorus communities.

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Online supplementary material

The online version of this article contains supplementary material (supplement 1: study sites, supplement 2: dendrogram and supplement 3: phytosociological tables).

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Appendix 1. Nomenclature type relevés of the newly described syntaxa

The nomenclature type of the subassociation *Spergulo vernalis-Corynephoretum canescen-
tis silenetosum nutantis* subass. nov.

**holotypus hoc loco:**
Marcetto (NO) (26.06.2009). Plot size: 10 m², Altitude: 155 m. Herb layer: 80%, moss–lichen layer: 15%.

Herb layer: *C. canescens* (L.) P. Beauv. 3, *T. nudicaulis* (L.) R.Br. +, *S. nutans* L. +, *H. piloselloides* Vill. 2, *R. caesius* L. +, *S. ocymoides* L. 2, *J. montana* L. +, *K. pyramidata* (Lam.) Domin +, *R. acetosella* L. 2, *Poa bulbosa* L. +, *S. perennis* L. +, *Herniaria glabra* L. +, *Petrorhagia saxifraga* (L.) Link +, *Aira caryophyllea* L./*Aira cupaniana* Guss. +, *Euphorbia cyparissias* L. +, *T. chamaedrys* L. 2, *Populus* sp. juv +, *P. tabernaemontani* Asch. +, *Poa compressa* L. 1, *Sanguisorba minor* Scop. +, *Vulpia myuros* (L.) Gmelin +, *Echium vulgare* L. +, *F. procumbens* (Dunal) G. et G. 1, *Stachys recta* L. +, *Galium lucidum* All. +.

The nomenclature type of the subassociation *Spergulo vernalis-Corynephoretum canescen-
tis artemisietosum campestris* subass. nov.

**holotypus hoc loco:**
Pombia (NO) (30.06.2009). Plot size: 6 m², Altitude: 170 m. Herb layer: 40%.

Herb layer: *C. canescens* (L.) P. Beauv. 3, *R. acetosella* L. 1, *H. glabra* L. +, *Petrorhagia saxifraga* (L.) Link +, *A. campestris* L. 2, *C. deusta* Ten. +, *H. perforatum* L. +, *C. dactylon* (L.) Pers. +, *A. caryophyllea* L./*A. cupaniana* Guss. +, *Euphorbia cyparissias* L. +, *T. chamaedrys* L. 2, *Populus* sp. juv +, *P. tabernaemontani* Asch. +, *Poa compressa* L. 1, *Sanguisorba minor* Scop. +, *Vulpia myuros* (L.) Gmelin +, *Echium vulgare* L. +, *F. procumbens* (Dunal) G. et G. 1, *Stachys recta* L. +, *Galium lucidum* All. +.