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### Syntaxonomy and synecology of *Erica cinerea* L. communities in the Alps (north-western Italy)

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**Abstract.** - The paper aims to assess the syntaxonomy of *Erica cinerea* disjointed communities in the southern Alps (Italy). A new subassociation *ericetosum cinereae subass. nova* is described within the *Chamaecytiso hirsuti-Callunetum vulgaris*. Two main geographical races are identified: geogr. race *typicum* in the Cozie Alps, and geogr. race with *Fraxinus ornus* in the Pennine Alps. Within the geographical races with *Fraxinus ornus*, two edaphic variants are described: var. edaph. with *Chrysopogon gryllus*, located on rocky soils and characterized by ingressive species of *Festuco-Brometea*, and var. edaph. with *Betula pendula*, located in relatively deeper soils and characterized by high total canopy cover. Shrub invasion is very rapid in particular in the geogr. race *typicum* and in the geogr. race with *Fraxinus ornus* var. edaph. with *Betula pendula*. **Key words** : *Chamaecytiso hirsuti-Callunetum vulgaris* - conservation - *Erica cinerea* - heaths - vegetation dynamics.

**Résumé.** - Ce travail décrit la syntaxonomie des communautés disjointes à *Erica cinerea* des Alpes du Sud (Italie). Une nouvelle sous-association *ericetosum cinereae* est décrite au sein du *Chamaecytiso hirsuti-Callunetum vulgaris*. Deux races géographiques y sont reconnues : race geogr. *typicum* dans les Alpes cottiennes et race geogr. à *Fraxinus ornus* dans les Alpes pennines. Deux variantes édaphiques sont décrites pour la race à *Fraxinus ornus* : var. édaph. à *Chrysopogon gryllus*, sur des sols rocaillieux et différenciée par des espèces ingressives de *Festuco-Brometea*, et var. édaph. à *Betula pendula*, sur des sols relativement plus profonds et caractérisée par une couverture abondante d'espèces ligneuses. L'invasion d'arbustes est très rapide en particulier dans la race geogr. *typicum* et dans la race geogr. à *Fraxinus ornus* var. édaph. à *Betula pendula*. **Mots clés** : *Chamaecytiso hirsuti-Callunetum vulgaris* - conservation - dynamique de la végétation - *Erica cinerea* - landes. received November 11, 2009, accepted December 14, 2009

#### I. INTRODUCTION

Bell heather (*Erica cinerea* L.) is a dwarf shrub spreading in oceanic south-western European heath communities, normally associated with well-drained acidic, mineral soils with little humus accumulation (Bannister, 1965; Webb & Rix, 1972). The species also occurs in the Mediterranean area in SE France, N Italy (Ligurian region), Corsica and Algeria (Allorge, 1927; Bannister, 1965; Serra, 1966). After 1980 many disjointed and small *E. cinerea* populations were discovered in the southern border of the Alps (NW Italy). The first observation in the Pennine Alps (NW Italy) was reported by Dal Vesco *et al.* (1985-86) near Curino, Biella province. After that, many other populations were found near the same site along a 2.5 km area (Badino & Soldano 1986; Badino *et al.*, 1986, Mondino in Benetti *et al.*, 2001). More recently *E. cinerea* was also found in Noca, Biella province (Rotti, 1993; Soldano & Sella, 2000) and in the Cozie Alps in Rifreddo, Cuneo province, at about 125 km distance from the other sites (Benetti *et al.*, 2001). One historical report about the presence of the species near Lago Maggiore, Verbania province (Biroli, 1808) was found to be unreliable (Badino *et al.*, 1986). At the present time, *E. cinerea* shows a relict distribution along the southern border of the Alps (Fig. 1), isolated geographically from its main European range. Serra (1966) supposed that the species migrated to Italy during an oceanic environmental change during the Pleistocene glaciation. Later *E. cinerea's* range became fragmented and it survived only in some small favourable climatic areas (subatlantic area of peripheral Alps). In its main European range, *E. cinerea* is found in a variety of habitats, ranging from pine forest, thin oakwood to dry and wet heath communities (Bannister, 1965; Rameau *et al.*, 1993). From the phytosociological point of view, *E. cinerea* is a characteristic species of Atlantic heath communities of the *Ulicion minoris* (Royer, 2008). The species finds its optimum in the

xerophilous suballiance *Ulicion minoris-Ericenion cinereae*. Its ecological plasticity allows *E. cinerea* to grow in other communities of the *Ulicetalia minoris* order (Rivas-Martinez *et al.* 2001; Botineau & Géhu, 2005): i) thermophilous heaths with Iberian-Atlantic range, included in the *Daboecion cantabricae*, ii) Atlantic heaths (with littoral ecotypes) of the *Dactylido maritimae-Ulicion maritimae* and iii) communities of the *Cisto salvifolii-Ericetea cinerea*, including thermophilous-dry heaths with Atlantic- Mediterranean range, characterised by the presence of *Cisto-Lavanduletea* ingressive species. In transitional bioclimatic areas, *E. cinerea* often occurs in the subcontinental heath communities of the *Vaccinio-Genistetalia*, in particular in the *Genistion pilosae* alliance (de Foucault, 1990; Botineau & Géhu, 2005; Bioret & Géhu, 2008). The *Genistion pilosae* could be considered as transitional between the Atlantic heaths and the boreal and subalpine heaths (de Foucault, 1990). Between this alliance, *E. cinerea* is reported as dominant or codominant species in different associations (De Smidt, 1977; Stieperaere, 1979; Øvstedal, 1985; Botineau & Ghestem, 1995, Botineau & Géhu, 2005): *Empetro-Ericetum cinereae* in western Norway, *Cytiso purgantis-Ericetum cinerae* in central and northern France (Massif central and Dordogne), *Calluno-Genistetum anglicae* in central and northwestern France, Netherlands and Belgium, and *Genisto pilosae-Ericetum cinereae* in central France (Limousin). This last association is characterized by copresence of the continental species *Genista pilosa*, to point out its transitional significance (Botineau & Géhu, 2005). On the contrary in the subcontinental heaths of the *Calluno-Genistetum pilosae*, Atlantic species (including *E. cinerea*) are usually totally absent (Botineau & Ghestem, 1995; Botineau & Géhu, 2005). At present very little information is available about the syntaxonomy of *E. cinerea* populations in the southern border of the Alps. Dal Vesco *et al.* (1985-86) reported five relevés localized in the first punctiform population observed near to Cascina Livera 495

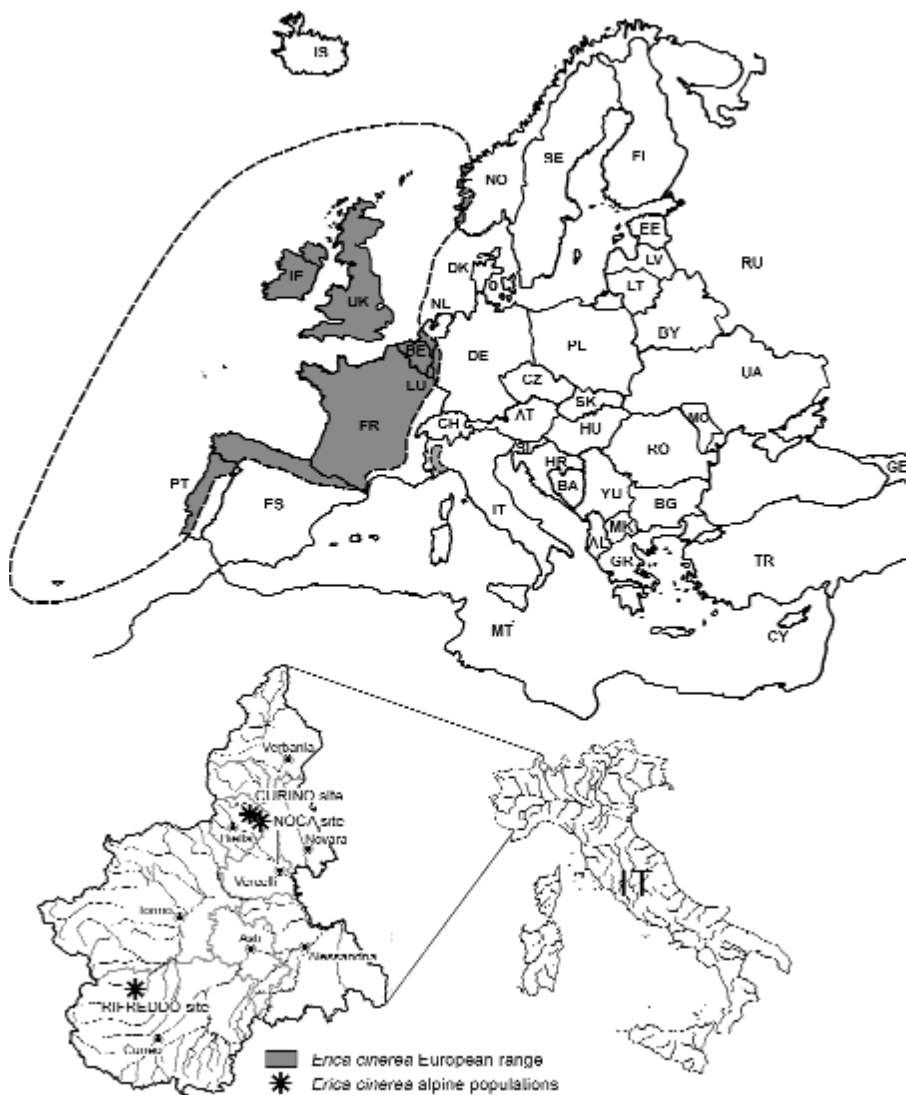


Fig. 1.- Location of *E. cinerea* populations in the southern border of the Alps (Piedmont, Italy).

Fig. 1.- Localisation des populations de *E. cinerea* dans les Alpes du Sud (Piémont, Italie). 496 (Curino site).

Benetti *et al.* (2001) also reported six relevés from Rifreddo (Cuneo). Both papers generically attributed the vegetation to *Nardo-Callunetea* (= *Calluno-Ulicetea*), but no other phytosociological data were discussed. Furthermore a large part of the known *E. cinerea* populations were not investigated from a vegetational point of view. For this paper a field study was carried on in 2007 to investigate the vegetational aspects of the southern Alps sites, with the aim i) to assess the syntaxonomy of *E. cinerea* disjointed communities in the southern Alps and ii) to describe the vegetation dynamics in order to suggest best management practices for conservation.

## II. MATERIALS AND METHODS

Relevés were carried out in May 2007, according to the phytosociological method, using the abundance-dominance values proposed by Braun-Blanquet (1932). The relevés reported by Dal Vesco *et al.* (1985-86) were repeated in the same area because they were conducted more than twenty years ago. Six relevés from the Rifreddo site were taken from Benetti *et al.* (2001). Phytosociological data were transformed into numerical values according to van der Maarel (1979). Data from 23 relevés were classified by cluster

analysis (option for clustering: average link; resemblance coefficient: similarity ratio). Mean Landolt indicator values (Landolt, 1977) were calculated for all relevés taking into account the cover values of each species (weighted mean); mean values were used as variables in a principal component analysis (PCA), in order to show the ecological difference among the surveys (Whittaker, 1967; Persson, 1981; Pignatti, 1998; Lonati, 2005). Cluster analysis and PCA were performed using the *Syn-Tax V* statistical package (Podani, 1995). Climate data in the study area were extrapolated for each survey, using UTM coordinates, from the Climatologic Atlas of Piedmont (Biancotti *et al.*, 1998). Floristic nomenclature follows Pignatti (1982). The syntaxonomical nomenclature follows Mucina *et al.* (1993), integrated with Oberdorfer (1964), Theurillat *et al.* (1994), Rivas-Martinez *et al.* (2001) and Poldini *et al.* (2004). Authors' standard form of syntaxon names follow Izco (2002).

### III. STUDY AREA

The study areas are located in NW Italy in Curino (Biella province), Noca (Biella province) and Rifreddo (Cuneo province) (Fig. 1). The bedrock is Permian siliceous quartz-porphry at the Curino and Noca sites (Marucchi & Oddone, 1986), and gneiss and micaschistous gneiss at the Rifreddo site (Benetti *et al.*, 2001). The areas have a similar, transitional continental-suboceanic temperate climate with moderately high precipitation. Yearly average precipitation ranges between 1418 and 1971 mm and mean annual temperatures between 10.5 and 11.9 °C (Biancotti *et al.*, 1998). At all sites, the precipitation distribution throughout the year is particularly favourable to vegetation development, due to the absence of a dry period in summer (June, July and August precipitation values ranging from 261 to 403 mm). Despite the high precipitation, during the summer dry conditions become common in the study area, due to the very shallow soils (Marucchi & Oddone, 1986; Benetti *et al.*, 2001). 497

### IV. RESULTS

#### A Syntaxonomy

The vegetation could be referred to *Chamaecytiso hirsuti-Callunetum vulgaris* (= *Genisto pilosae-Callunetum illyricum* sensu Feoli, Pignatti & Pignatti 1981 non Horvat). This is confirmed by the constant presence of many characteristic and differential species of the association and of the alliance *Genistion pilosae* (Oberdorfer, 1964; Theurillat *et al.*, 1994; Poldini *et al.*, 2004): *Pteridium aquilinum*, *Genista germanica*, *Danthonia decumbens*, *Lembotropis nigricans*, *Genista pilosa* and *Chamaecytisus hirsutus* (Table I). Notably, in our relevés, the characteristic euatlantic species from the *Ulicion minoris* alliance are totally absent. *Chamaecytiso hirsuti-Callunetum vulgaris* is reported in the southern Alps as a variant of the Centro-European *Cytiso supini-Callunetum vulgaris*, as secondary mesotemperate *Calluna vulgaris* heaths located around the Insubria region (Poldini *et al.*, 2004). Occurrence of this association was also reported for the western Alps (Liguri, Maritime and Cozie Alps) by Aubert *et al.* (1971). The *Chamaecytiso hirsuti-Callunetum vulgaris* includes the *Gryllo-Callunetum vulgaris nom. prov.* described by Antonietti (1970) in Insubria and Canton Ticino. The dominant and constant presence of *E. cinerea* within the community (diagnostic and physiognomical species, not described by others) leads us to define a new subassociation *ericetosum cinerea subass. nova* (holotypus relevé 2, Table I). This subassociation is commonly located in the outer south-western Alps (Italy) and includes all the disjointed peripheral populations of *E. cinerea* (differential species of the subassociation).

#### B. Variability

Cluster analysis identifies two main geographical races within the subassociation (Fig. 2 and Table I): 1) geogr. race *typicum*, located in the Cozie Alps (Rifreddo station) and differentiated by high frequencies of *Genista pilosa*, characteristic species of the *Genistion pilosae* alliance; 2) geogr. race with *Fraxinus ornus*, located in the Pennine Alps (Curino and Noca sites) and differentia-

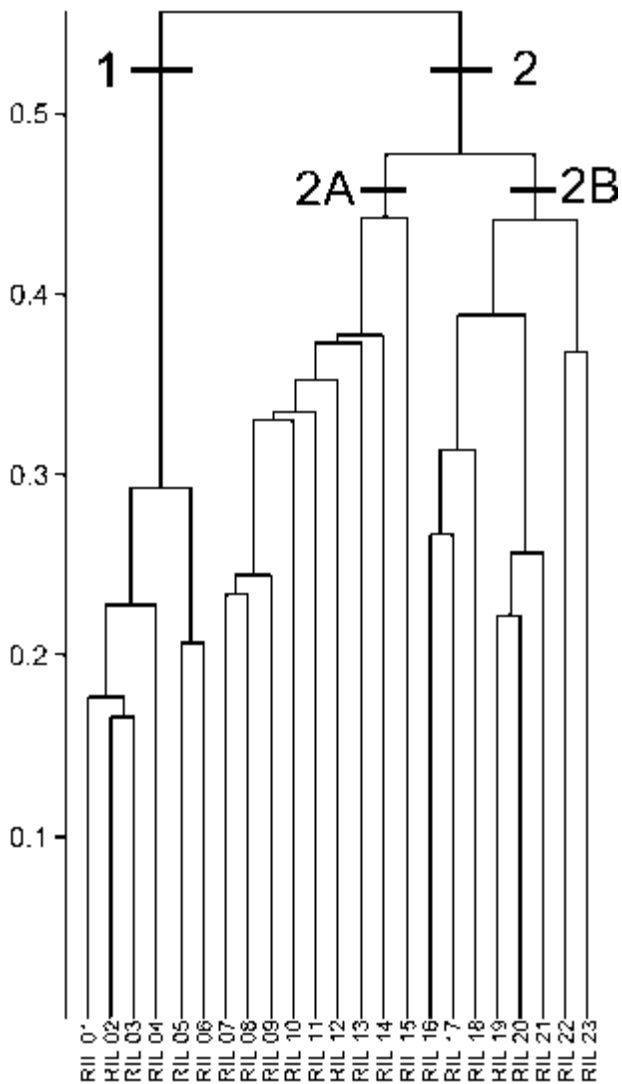


Fig. 2.- Dendrogram of phytosociological relevés (option for clustering: average link; resemblance coefficient: similarity ratio); 1: geogr. race *typicum*, 2: geogr. race *Fraxinus ornus*, 2A: var. edaph. *Chrysopogon gryllus*, 2B: var. edaph. *Betula pendula*.

Fig. 2.- Dendrogramme des relevés phytosociologiques.

ted by the presence of many thermophilous species. In NW Italy, *Fraxinus ornus* is found only in the Insubrian area and in the outer Maritime Alps (Terzuolo *et al.*, 2002). The thermophilous character of the coenosis results in a higher species richness than in the geogr. race *typicum* (average number of species = 18.9 vs 9.5 species, F-test with  $p < 0.001$ ). Within the *Fraxinus ornus* geographical race we distinguish two edaphic variants (Table I): A) var. edaph. with *Chrysopogon gryllus*, located on rocky soils with high surface leakage (average stone cover 10%, average bare ground 21%) which favoured *Chrysopogon gryllus* and other ingressive species of *Festuco-Brometea*; B) var. edaph. with *Betula pendula*, located in mesotemperate micro-topography stands, characterized by relatively deeper soils (average stone cover 0%, average bare ground 17%) and relative high total canopy cover (average 43%).

### C. Synecology

The PCA performed using the mean Landolt indicator values confirms the thermophilous character of the geogr. race with *Fraxinus ornus*, due to higher temperatures values (T) than for the geogr. race *typicum*

(Fig. 3). Lower soil humus content (H), dispersion (D) and moisture (U) indices are also found in the geogr. race with *Fraxinus ornus* var. edaph. with *Chrysopogon gryllus* than in the *typicum* geographical race, confirming the presence of very primitive and coarse soils in the first community. This is also characterized by higher reaction values (R) than the other coenoses, due to lack of organic matter and correlated acidification in the very open soils. The geogr. race with *Fraxinus ornus* var. edaph. with *Betula pendula* shows intermediate mesophilous soil conditions compared with the var. edaph. *Chrysopogon gryllus* due to a notable development of soil and vegetation (Fig. 3).

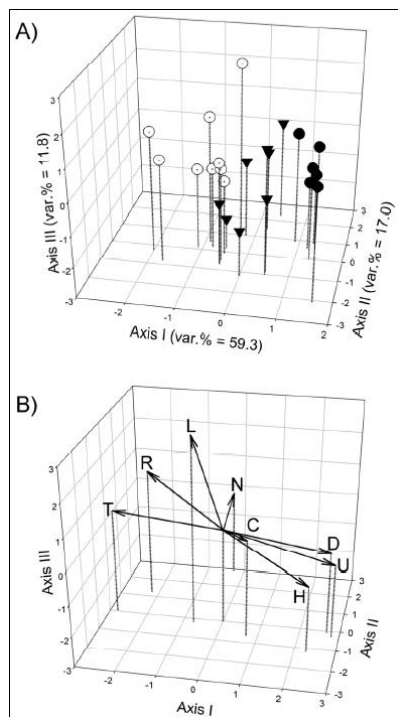


Fig. 3.- Ordination of relevés (PCA) using mean Landolt indicator values. U = moisture, N = nitrogen, T = temperature, R = soil reaction, C = continentality, L = light, D = soil dispersion, H = humus content. (Q) geogr. race *typicum*, (R) geogr. race *Fraxinus ornus* var. edaph. *Chrysopogon gryllus*, (▼) geogr. race *Fraxinus ornus* var. edaph. *Betula pendula*.

Fig. 3.- Analyse en composantes principales réalisée sur la base des valeurs moyennes d'indice de Landolt.

#### D. Syndynamics

*Chamaecytiso hirsuti-Callunetum vulgaris ericetosum cinerea* can be considered as a secondary degradation stage due to fire and grazing of mixed oak forests (*Quercus petraea*/*Q. pubescens*). In the past, fire management played an important role in determining this coenosis, as well indicated by the abundance of *Molinia arundinacea*, known as pyrophytic species (Ellemborg, 1988). The subassociation is syndynamically connected with *Hieracio tenuiflori-Quercetum roboris*, described in the Insubrian area (Oberdorfer, 1964; Hofmann, 1965). In recent decades abandonment of traditional management practices (pastoral burning followed by grazing) has resulted in the spread of shrubs. The increased shade favours the arrival and development of *Trifolio-Geranietea* and *Rhamno-Prunetea* ingressive species, which contribute to the evolution of the coenosis towards a *Querco-Fagetea* community (Table I). Within the geographical race with *Fraxinus ornus*, the two edaphic variants are linked to soil evolution, with the var. edaph. with *Betula pendula* intermediate towards climatophilous broadleaf forests. In the study area *E. cinerea* seems to be more tolerant than *Calluna vulgaris* to increased canopy cover due to the successional development (Fig. 4). This agrees with Bannister (1965) who states that *E. cinerea* is less adversely affected by shade than *Calluna*. This linear response occurs probably in very open woodland habitats, because the total cover from the upper canopy and the stratification of woody species may have a negative effect on the long-term



performance of the species. *Erica cinerea* is mainly spread by seed (Turner & Conran, 2004) but germination usually occurs only in the presence of light. Strong litter accumulation usually inhibits germination and seedling survival (Mallik *et al.*, 1984).

## V. DISCUSSION

In the southern border of the Alps (NW Italy) *E. cinerea* populations are all included in the *Chamaecytiso hirsuti-Callunetum*, originally described by Oberdorfer (1964) in the Insubrian area and

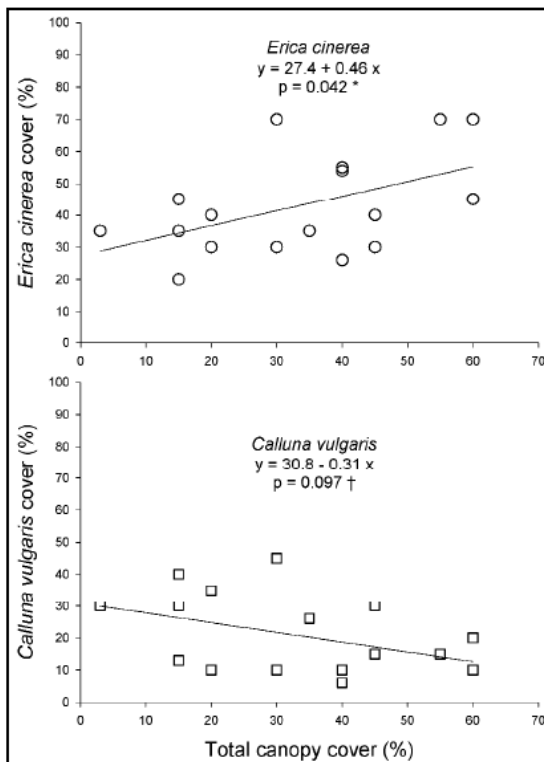


Fig. 4.- Relationship between *Erica cinerea* and *Calluna vulgaris* cover and the total canopy cover (\*:  $0.05 < p \leq 0.01$ ; †:  $0.10 < p \leq 0.05$ ).

Fig. 4.- Relations entre la couverture de *Erica cinerea* et *Calluna vulgaris* et la couverture ligneuse totale (\*:  $0.05 < p \leq 0.01$ ; †:  $0.10 < p \leq 0.05$ ).

Accidental species of relevés. Ril 07: *Arctostaphylos uva-ursi* (L.) Sprengel (+); Ril 12: *Hieracium sylvaticum* (L.) L. (+); Ril 16: *Eupatorium cannabinum* L. (+); Ril 20: *Polygala chamaebuxus* L. (+). widespread in all the southern Italian Alps (Aubert *et al.*, 1971; Poldini *et al.*, 2004). A new subassociation, *ericetosum cinereae subass. nova*, is here described, using *E. cinerea* as differential species. The populations studied are referred to the subcontinental alliance *Genistion pilosae* (Table I). In the study area we did not observe any geographical contact with the Atlantic heaths of the *Ulicion minoris* (those character species were here totally absent), separated by the geographic barrier of the Alps and N-Apennines. Despite the fact that *E. cinerea* is very common in its main south-western European range, the disjoint occurrences in the southern Alps are very interesting for their relict significance. Although the species is included in the Italian red list (Conti *et al.*, 1997), up till now none of the study sites is included in a protected area. Some of the known populations (Rifreddo, Curino) are partially threatened by human activities, being located in areas subjected to quarry extraction. Due to the secondary character of these coenoses, a large and active management plan should be encouraged to avoid the local extinction of *E. cinerea* and to increase opportunities for its regeneration. In the study area heathlands are currently under threat for conversion to

woodland, due to the conspicuous abandonment of traditional management practices (fire and pasture), as also similarly observed in other parts of Europe (Thompson *et al.*, 1995; Webb, 1998). Shading can negatively influence species composition in heaths and cause disappearance of understory species (Vilà & Sardans, 1999). Although *E. cinerea* in the study area shows adaptation to the early stages of shrub development (Fig. 4), the species preferentially grows in open heaths, avoiding coenoses with rich woody litter accumulation. Furthermore the establishment and survival of *E. cinerea* seedlings is lower in closed heathland vegetation than in open areas (Bullock & Moy, 2004). The long-term vegetational trend could be a threat for *E. cinerea* populations in the southern Alps. Nevertheless seed of the species can persist in the soil seed bank for over thirty years and may allow recovery or expansion if the area is opened up by fire (Mallik *et al.*, 1984; Thompson & Band, 1997). In dry heathlands *E. cinerea* does not appear to be very sensitive to grazing (Gallet & Rozé, 2001) and the species is presumed to be less palatable to sheep than *Calluna* (Gimingham, 1949; Bannister, 1965). Fire is also supposed to have a beneficial effect because a short heat shock substantially increases *E. cinerea* seed germination (Bannister, 1965). This may explain the temporary dominance of *E. cinerea* after burning, more stimulated than *Calluna* (Whittaker & Gimingham, 1962). However, many factors may influence vegetational dynamics after burning, such as plant regeneration, ash accumulation, erosion and persistence of an active seed bank (Clément, 2008). Management practices with a long-term conservational purpose should be defined by the combined use of different prescribed fire regimes with different stocking rates and grazing levels. Shrub development is very rapid in particular in the geogr. race *typicum* (Rifreddo site) and in the geogr. race with *Fraxinus ornus* var. edaph. with *Betula pendula* (Curino and Noca sites, mesophilous conditions). Consequently in these situations conservation management should be encouraged to avoid tree encroachment. On the contrary in the geogr. race with *Fraxinus ornus* var. edaph. with *Chrysopogon gryllus*, characterized by rocky soils, shrub invasion is very slow and is only a secondary threat to *E. cinerea*. The large distance that separates the studied populations suggests that the species could be present at other sites, especially in the outer Alps near the Insubrian region, in similar geological and climatic conditions. A genetic study aimed at verifying the presence of different ecotypes in the southern Alps would be illuminating. For instance, Ellenberg indicator values (Ellenberg *et al.*, 1992, readapted by Pignatti, 2005) indicate *E. cinerea* as a more heliophilous species than *Calluna* (light indicator values L = 9 vs 8). This difference, even if weak, is in contrast with our observations: in the initial phase of tree encroachment *E. cinerea* seems to be more persistent than *Calluna* (Fig. 4). This ecological difference, noted between the typical W-European *E. cinerea* populations and the ones studied, may indicate that two or more ecotypes probably differentiated from a common ancestor as a consequence of range fragmentation after the Pleistocene glaciations. No information is available on the response to management of the southern Alps populations, taking into account the differences in climate (subcontinental rather than oceanic). A long-term experiment should be planned in the study areas with a rotational use of prescribed fire and grazing, to provide the best approaches to control shrub and tree development..

Table I.- Phytosociological table (\* rel. from Benetti *et al.*, 2001 ; na = not available).  
 Tableau I.- Tableau phytosociologique.

N° relèves	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	P	F
Area (x 10 m <sup>2</sup> )	10	10	10	20	5	10	10	10	10	10	10	10	10	10	10	6	10	10	10	10	10	10	10		
Altitude (x 10 m)	60	60	60	60	62	54	48	55	43	62	63	48	49	44	40	44	67	47	42	38	57	57	43		
Exposure (°N)	SSW	S	S	S	S	SSW	148	272	262	220	138	98	230	122	182	92	170	240	152	166	292	40	156		
Slope (°)	na	na	na	na	na	na	8	22	24	15	27	24	32	23	10	18	19	27	8	11	32	40	16		
Canopy cover (%)	na	na	na	na	na	na	3	30	40	40	15	15	20	15	45	60	40	45	30	20	60	35	55		
Bare ground (%)	na	na	na	na	na	na	15	20	30	15	20	10	35	10	30	10	10	20	2	15	25	35	15		
Stone clover (%)	na	na	na	na	na	na	-	-	20	10	5	5	5	25	20	-	-	-	-	-	-	-	-		
	geogr. race <i>typicum</i>						geogr. race <i>Fraxinus ornus</i>																		
							var. edaph. <i>Chrysopogon gryllus</i>					var. edaph. <i>Betula pendula</i>													
Diff. species of <i>Chamaecytisus hirsuti</i> - <i>Callunetum vulgaris</i>																									
<i>Pteridium aquilinum</i>	1	2	+	+	2	4	+	.	.	1	+	.	+	.	+	2	+	2	2	2	.	.	+	18	IV
<i>Genista germanica</i>	.	.	.	.	.	.	+	.	+	.	.	1	+	.	.	+	.	1	1	+	.	.	.	9	II
<i>Danthonia decumbens</i>	.	+	.	+	.	+	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	6	II
Diff. species of subass. <i>ericetosum cinerea</i>																									
<i>Erica cinerea</i>	3	3	3	2	1	1	3	3	3	4	2	3	3	3	3	4	4	3	4	3	3	3	4	23	V
Charact. (c) and diff. (d) species of <i>Genistion pilosae</i> ( <i>Vaccinio-Genistetalia</i> )																									
d <i>Lembotropis nigricans</i>	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	+	+	.	.	.	5	II
c <i>Genista pilosa</i>	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	I
d <i>Chamaecytisus hirsutus</i>	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1	I
Charact. species of <i>Calluno-Ulicetea</i>																									
<i>Calluna vulgaris</i>	2	2	3	4	3	2	3	3	2	2	3	3	2	2	2	2	3	2	3	2	3	2	2	23	V
<i>Genista tinctoria</i>	.	.	.	.	.	.	.	.	.	+	1	1	1	.	.	+	.	.	+	.	.	.	.	6	II
<i>Potentilla erecta</i>	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	+	.	.	.	5	II
<i>Carex pilulifera</i>	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	2	
<i>Festuca tenuifolia</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	I
Companion species																									
Ingressive species of <i>Festuco-Brometea</i>																									
<i>Chrysopogon gryllus</i>	.	.	.	.	.	.	1	+	2	1	1	2	2	2	1	+	+	.	.	+	.	.	.	12	III
<i>Centaurea bracteata</i>	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1	I
<i>Hippocrepis comosa</i>	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1	I
<i>Teucrium chamaedrys</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	I
<i>Thymus pulegioides</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	I
<i>Brachypodium caespitosum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1	I
Ingressive species of <i>Trifolio-Geranietea sanguinei</i>																									
<i>Anthericum liliago</i>	+	.	.	.	.	.	.	+	.	+	1	.	+	+	+	+	.	.	.	.	.	.	.	9	II
<i>Vincetoxicum hirundinaria</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	4	I
<i>Peucedanum oreoselinum</i>	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	2	I
<i>Viola hirta</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	2	I
<i>Peucedanum cervaria</i>	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	I
Ingressive species of <i>Rhamno-Prunetea</i>																									
<i>Frangula alnus</i> (ai)	.	+	+	.	+	+	+	.	+	.	.	.	.	.	.	+	.	.	+	+	+	+	+	12	III
<i>Amelanchier ovalis</i> (as)	.	.	.	.	.	.	+	.	.	+	+	.	1	.	1	.	.	.	.	.	.	.	.	10	
(ai)	.	.	+	.	+	.	.	1	+	.	.	1	.	.	.	+	1	.	.	.	.	.	.		
<i>Rubus ulmifolius</i>	.	.	.	.	.	.	.	.	+	+	.	+	1	.	+	+	.	.	.	.	.	.	.	7	II
<i>Cytisus scoparius</i> (ai)	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	+	.	.	.	.	.	+	5	II
<i>Rosa canina</i>	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	2	I
<i>Berberis vulgaris</i> (ai)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	I
Ingressive species of <i>Quercu-Fagetea</i>																									
<i>Fraxinus ornus</i> (as)	.	.	.	.	.	.	1	1	2	3	1	2	2	2	3	2	.	.	.	.	.	.	.	15	IV
(ai)	.	.	.	.	.	.	+	+	1	.	1	1	1	1	1	.	+	.	.	.	+	.	.		
(sem)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.		
<i>Castanea sativa</i> (A)	.	.	.	.	.	.	.	.	.	2	1	1	.	.	.	2	.	.	.	.	+	2	.		
(as)	.	.	.	.	.	.	+	2	1	.	.	.	.	.	+	2	2	.	2	2	2	1	.	14	IV
(ai)	.	1	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	.	.		
<i>Teucrium scorodonia</i>	.	+	.	.	.	.	.	.	.	1	+	+	.	.	+	+	+	.	.	.	+	+	.	10	III



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**Appendix 1.** Syntaxonomic list. *Chamaecytiso hirsuti-Callunetum vulgaris* Oberdorfer 1964 *ericetosum cinereae subass. nova* (holotypus relevé 2, Table I) *Genistion pilosae* Duvigneaud 1942 *Vaccinio-Genistetalia* Schubert 1960 *Calluno-Ulicetea* Br.-Bl. et Tüxen ex Klika et Hadač 1994

**Appendix 2.** Other syntaxa quoted in the text. *Calluno vulgaris-Genistetum anglicae* Tüxen 1937 *Calluno vulgaris-Genistetum pilosae* Oberdorfer 1938 *Cisto-Lavanduletea* Br.-Bl. in Br.-Bl., Molinier & Wagner 1940 *Cytiso purgantis-Ericetum cinerae* (Baudière 1975) Géhu 1975 *Cytiso supini-Callunetum vulgaris* Oberdorfer 1957 *Daboecion cantabricae* (Dupont 1975) Rivas-Martinez 1979 *Dactylido maritimae-Ulicion maritimae* Géhu 1975 *Empetro hermaphroditi-Ericetum cinereae* Birse & Robertson 1976 *Festuco-Brometea* Br.-Bl. & Tüxen ex Klika & Hadač 1944 *Genisto pilosae-Ericetum cinereae* Géhu 1994 *Gryllo-Callunetum vulgaris nom. prov.* Antonietti 1970 *Hieracio tenuiflori-Quercetum roboris* Oberdorfer 1964 *Nardo-Callunetea* Preising 1949 *Quercu-Fagetea* Br.-Bl. & Vlieger in Vlieger 1937 *Rhamno-Prunetea* Rivas Goday & Borja Carbonell 1961 *Trifolio-Geranietea sanguinei* Müller 1961 *Ulicetalia minoris* (Duvigneaud 1944) Géhu 1975 *Ulicion minoris* Malcuit 1929 *Ulicion minoris-Ericenion cinereae* Géhu 1975