LAZAROA 24: 61-85. 2003 ISSN: 0210-9778

Brometalia erecti Br.-Bl. 1936 grasslands from Antiapennine calcareous massifs of central-southern Tuscany (central Italy)

Claudia Angiolini, Costanza Riccucci & Vincenzo de Dominicis (*)

Resumen: Angiolini, C., Riccucci, C. & De Dominicis, V. *Pastizales del orden Brometalia erecti Br.-Bl. 1936 de los macizos calcáreos antiapenínicos del centro y sur de la Toscana (Italia central). Lazaroa 24: 61-85 (2003).*

Se recogen en el presente trabajo las características florísticas, sintaxonómicas y sinecológicas de los pastizales del orden Brometalia erecti de los macizos calcáreos del centro y sur de la Toscana. 64 inventarios fitosociológicos recogidos en las campañas de 1997, 2000 y 2001 fueron analizadas mediante técnicas de análisis multivariables. Estos pastos aparecen en areas de clima templado oceánico, de termotipos colino y montano y ombrotipos subhúmedo a hiperhúmedo, en contacto serial con bosques de *Ostrya carpinifolia* Scop. y con hayedos en las zonas más elevadas. Las comunidades reconocidas fueron las siguientes: *Cerastio etrusci-Brometum erecti ass. nova (Phleo-Bromion* Biondi & Blasi *ex* Biondi & *al.* 1995), pastizales xéricos en laderas de pendiente más o menos moderada sobrelitosuelos básicos de los pisos bioclimáticos colino y montano. Se han reconocido dos variantes relacionadas con las características físicas y químicas de los suelos; asimismo su comparación con vegetación similar de otras áreas apeníncas, más hacia el este, confima su autonomía. *Trifolio incarnati-Brometum erecti* Oberdorfer & Hofmann 1967 (Bromion W. Koch 1926), conocida de la Liguria apenínica aunque en el área estudiada hemos reconocido la subasociación *phleetosum ambigui,* que incluye una variante mesófila con *Arrhenatherum elatius,* de lugares expuestos al norte en el piso montano y ligado a suelos maduros con humedad edáfica durante todo el año, rica en especies transgresivas de *Molinio-Arrhenatheretea* Tx. 1937. En ella se ha reconocido una variante subnitrófila de *Carlina corymbosa,* relacionada con ganadería y exclusiva de suelos con gran componente arcilloso, se trata de una variante cercana a otros pastizales xerofíticos. El estudio también confirma la presencia de la alianza *Phleo-Bromion* en áreas aisladas de la Toscana similares a las del sector Tirrénico.

Abstract: Angiolini, C., Riccucci, C. & De Dominicis, V. *Brometalia erecti Br.-Bl. 1936 grasslands from the Antiapennine calcareous massifs of central-southern Tuscany (central Italy). Lazaroa 24: 61-85 (2003).*

Floristic characteristics, syntaxonomy and synecology of grasslands of the order *Brometalia erecti* on calcareous massifs of central-southern Tuscany are reported. Multivariate analysis was used to compare 64 phytosociological relevés made in the years 1997, 2000 and 2001. These pastures occur in areas of the temperate oceanic region, with upper hill to montane thermotype and lower humid to lower hyperhumid ombrotype, in serial contact with woods of *Ostrya carpinifolia* Scop. and with beech woods on summits. The plant communities surveyed were classified in the following associations: i) *Cerastio etrusci-Brometum erecti ass. nova (Phleo-Bromion* Biondi & Blasi *ex* Biondi & *al.* 1995), identified for xeric grasslands on moderate to steep slopes with basic lithosols in the hill and lower montane belts; it has two variants related to soil chemical and physical characters; comparison with similar vegetation of other Apennine areas confirms the western connotation and autonomous nature of these communities; ii) *Trifolio incarnati-Brometum erecti* Oberdorfer & Hofmann 1967 (*Bromion* W. Koch 1926), known from the Ligurian Apennine downwards; in the area studied it shows a new «Antiapenninic» subassociation named *phleetosum ambigui* that includes: a mesophilous variant with *Arrhenatherum elatius,* related to flat or north-exposed stations in the mountain belt linked to mature soils with high moisture all year, rich in transgressive species of the class *Molinio-Arrhenatheretea* Tüxen 1937; a subnitrophilous variant with *Carlina corymbosa,* related to grazing and exclusive to soils with high clay component; a transition variant towards xerophilous grasslands. The study confirms the presence of the alliance *Phleo-Bromion* in Tuscany as an isolated appendage with northern outposts of xerocalcicolous communities widespread in the central-southern Apennine; a similarity with vegetation of northern Tyrrhenian sectors was also observed.

INTRODUCTIÓN

The order *Brometalia erecti* was proposed by Braun-Blanquet in 1936 to classify calcicolous grasslands replacing deciduous forest vegetation in temperate and submediterranean bioclimate. Its distribution is subatlantic-western submediterranean including the western part of the middle European region as well as the submediterranean zone of Italy; in the southern part of its distribution, it largely coincides with mountain chains (ROYER, 1991). Grasslands belonging to this order occupy large areas of peninsular Italy, occurring throughout the Apennines from Liguria to Calabria, in southern sectors of the Alps and in one site in Sicily (BIONDI & *al.*, 1995).

* Dipartimento di Scienze ambientali «G. Sarfatti», Università degli Studi di Siena, via P.A. Mattioli, 4. I-53100 Siena.

In Tuscany, these grasslands are relatively unmapped. In the distribution map of *Brometalia erecti* published by BIONDI & *al.* (1995) for the Apennines, a large information gap is evident for Tuscany. The lack of data and the impoverished of species with respect to communities described for the Apennines has only enabled relevés to be classified at the rank of alliance (MACCHERINI & *al.*, 2001; ANGIOLINI & DE DOMINICIS, 1998-1999; BONINI & *al.*, 1999; CASINI & DE DOMINICIS, 1999; CHIARUCCI & *al.*, 1995; DE DOMINICIS & *al.*, 1986; LOMBARDI & *al.* 1998; MACCHERINI & *al.*, 2000; SCOPPOLA & ANGIOLINI, 1997). Only recently the vegetation belonging to *Bromion erecti* has been classified down to the rank of association: *Pseudolysimachio barrelieri-Brometum erecti* for the calanques of Radicofani (MACCHERINI & *al.*, 1998), *Onobrychido-Brometum* for the Chianti area (CASINI & DE DOMINICIS, 1999), *Seselio tortuosi-Brometum erecti* for external terraces of braided streams (ANGIOLINI & DE DOMINICIS, 2001).

Research on grasslands of the order *Brometalia erecti* on calcareous massifs of central-southern Tuscany is important because: i) these communities are among the most beautiful and species rich; ii) they are classified as habitats of Community importance in Annex I of the Habitats Directive 92/43/EEC (Habitat codes from 34.31 to 34.34, arid seminatural grasslands on calcareous substrates [ROMÃO, 1996]); iii) they are currently regressing in quality and quantity due to neglect.

The aim of the present study was to analyse the floristic characteristics, syntaxonomy and synecology of these grasslands using numerical clustering techniques and ordination methods.

STUDY AREA

The investigated southern Tuscan reliefs are largely calcareous massifs in the inner Antiapennine area (Siena and Grosseto provinces, Figure 1). They include Mt. Labbro (ML) 1192 m, Mt. Buceto (MB) 1168 m, Mt. Aquilaia (MA) 1104 m and Mt. Civitella (Mci) 1107 m, all SW of Mt. Amiata (Grosseto) and formed before the volcano Amiata (Eocene, Cretaceous). We also investigated Mt. Cetona (Mce) 1148 m, a narrow ridge running N-S, in SE Tuscany (Siena), consisting largely of Mesozoic limestone, and the Cornate di Gerfalco (CG) 1060 m, a rocky crest running NW-SE belonging to the central part of the Tuscan Antiapennine (Grosseto, Siena), with extensive outcrops of Jurassic «calcare massiccio» (JACOBACCI & *al.*, 1965; LAZZAROTTO, 1993).

These massifs have an interesting palaeogeographic collocation. During the Lower Pliocene marine transgression they remained dry and can therefore be regarded as fossil islands of an archipelago formed in that epoch (LANZA, 1984). This is indicated by floristic similarities between the various areas, including species of extreme biogeographical interest, such as *Viola etrusca, Cerastium arvense* ssp. *arvense* var. *etruscum, Erysimum pseudorhaeticum, Ornithogalum orthophyllum* and *Crocus biflorus*.

Thermopluviometric data (Tables 1 and 2) indicates that climate is similar in the various areas, with substantial differences in temperature and rainfall. According to the classification of THORNTWHAITE (1948), climate is mesothermic, subhumid to humid with moderate summer drought (Roccalbegna, Cetona, Gerfalco) to perhumid with moderate or no summer drought (Santa Fiora and Selvena) (BARAZZUOLI & *al.*, 1993). Phytoclimate (BIONDI & BALDONI, 1994; BLASI, 1996) is temperate oceanic with upper hill to montane thermotype and lower humid to lower hyperhumid ombrotype. Potential vegetation of moderate slopes consists largely of mixed deciduous calcicolous and mesoxeric woods with *Ostrya carpinifolia* and subordi-

Table 1
Meteorological data of study area localities.
Mean monthly and yearly temperature (in °C) (1951-1980)

Localities	Altitude (m a.s.l.)	J	F	M	A	M	J	J	A	S	O	N	D	Year
Cetona (SI)	384	6,5	7,6	9,9	13,2	17,4	21,0	24,3	24,1	21,3	16,3	11,4	7,5	15,0
Selvena (GR)	640	4,2	4,8	6,9	10,4	14,4	18,3	21,4	21,2	17,6	13,0	8,5	5,5	12,2
Gerfalco (GR)	732	3,8	4,2	6,4	9,7	13,9	17,8	20,9	20,9	17,3	12,6	8,0	4,8	11,7
Roccalbegna (GR)	525	5,0	6,1	7,8	10,7	14,7	18,3	21,6	21,6	18,3	14,2	9,6	6,3	12,9
Santa Fiora (GR)	687	4.5	5.6	7.3	10.4	13.4	17.0	20.7	21.1	17.1	13.2	9.0	6.0	12.1

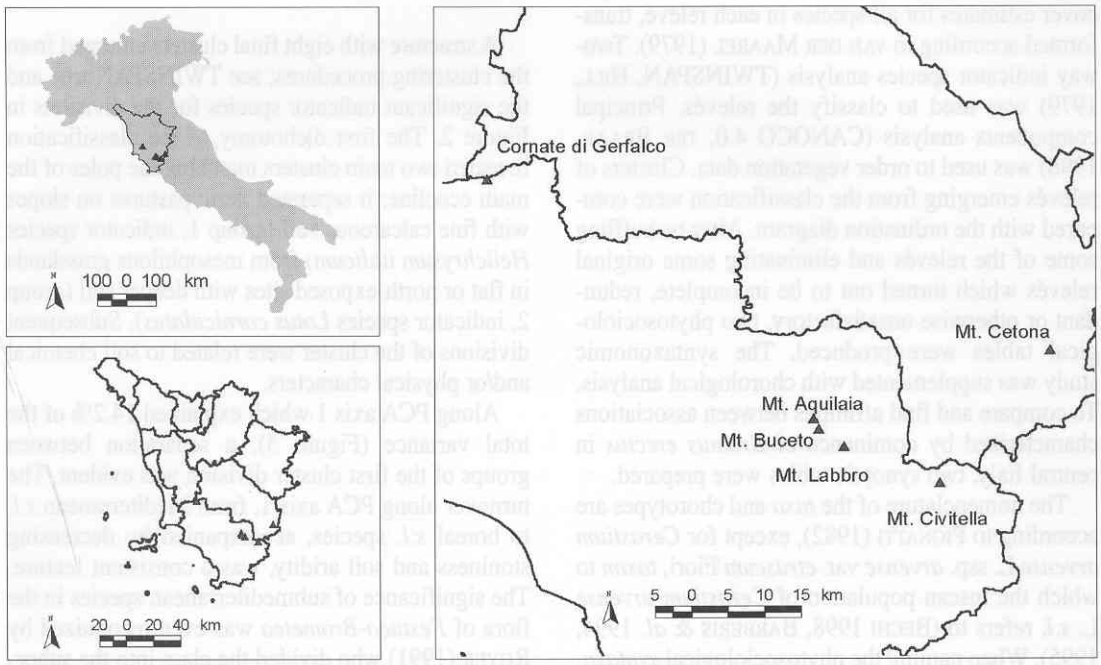

Figure 1.—Study areas and their geographical location.

Table 2
Meteorological data of study area localities.
Mean monthly and yearly rainfall (in mm) (1951-1980)

Localities	Altitude (m a.s.l.)	J	F	M	A	M	J	J	A	S	O	N	D	Year
Cetona (SI)	384	96,3	96,8	82,1	76,0	75,5	53,8	38,1	54,0	83,8	107,3	141,5	103,0	1008,2
Selvena (GR)	640	150,6	168,3	130,8	121,1	89,4	63,9	62,4	69,3	101,6	122,0	184,1	175,3	1438,8
Gerfalco (GR)	732	101,3	106,4	87,9	86,1	83,4	58,0	32,3	47,1	87,4	114,1	134,4	108,1	1046,5
Roccalbegna (GR)	525	130.3	134.1	111.7	106.7	77.1	63.3	40.1	59.6	107.5	118.6	170.1	145.3	1264.4
Santa Fiora (GR)	687	147.4	165.0	137.3	130.7	84.3	62.8	45.6	63.8	123.7	140.7	198.9	168.5	1468.7

nately *Acer obtusatum*, *Fraxinus ornus* and locally *Quercus cerris* (*Quercetalia pubescenti-petraeae*). On summits and north-exposed slopes of Mts. Cetona and Civitella, there are also beech woods (*Fagion sylvaticae*); occasional specimens of beech in wooded patches suggest that summits of most of the other massifs also have potential for beech woods.

Low anthropization and interesting floral and faunal elements are the main reasons that four Regional nature reserves (Monte Labbro, Rocconi, Pescinello, Cornate and Fosini) have been instituted in these areas.

MATERIAL AND METHODS

During the years 1997, 2000 and 2001, 64 relevés were made according to the Braun-Blanquet phytosociological method (WESTHOFF & VAN DER MAAREL, 1978). The relevés were made bearing in mind that grasslands are normally mosaic vegetation; all species of vascular plants as well as some environmental factors (elevation, aspect, inclination, stoniness, vegetation cover) were recorded at each site.

To obtain an effective description of community types, both classification and ordination techniques

were carried out on the matrix of Braun-Blanquet cover estimates for all species in each relevé, transformed according to VAN DER MAAREL (1979). Two-way indicator species analysis (TWINSPAN, HILL, 1979) was used to classify the relevés. Principal components analysis (CANOCO 4.0, TER BRAAK, 1998) was used to order vegetation data. Clusters of relevés emerging from the classification were compared with the ordination diagram. After reshuffling some of the relevés and eliminating some original relevés which turned out to be incomplete, redundant or otherwise unsatisfactory, two phytosociological tables were produced. The syntaxonomic study was supplemented with chorological analysis. To compare and find affinities between associations characterized by dominance of *Bromus erectus* in central Italy, two synoptic tables were prepared.

The nomenclature of the *taxa* and chorotypes are according to PIGNATTI (1982), except for *Cerastium arvense* L. ssp. *arvense* var. *etruscum* Fiori, *taxon* to which the tuscan population of *Cerastium arvense* L. *s.l.* refers to (BECHI 1998, BARBERIS & *al.* 1994, 1995). When naming the phytosociological *syntaxa*, the 3rd edition of the International Code of Phytosociological Nomenclature was followed (WEBER & *al.*, 2000).

RESULTS & DISCUSSION

A structure with eight final clusters emerged from the clustering procedures; see TWINSPAN tree and the significant indicator species for the divisions in Figure 2. The first dichotomy of the classification revealed two main clusters matching the poles of the main ecocline; it separated xeric pastures on slopes with fine calcareous soil (group 1, indicator species *Helichrysum italicum*) from mesophilous grasslands in flat or north-exposed sites with deeper soil (group 2, indicator species *Lotus corniculatus*). Subsequent divisions of the cluster were related to soil chemical and/or physical characters.

Along PCA axis 1 which explained 14.2% of the total variance (Figure 3), a separation between groups of the first cluster division was evident. The turnover along PCA axis 1, from Mediterranean *s.l.* to boreal *s.l.* species, accompanied by decreasing stoniness and soil aridity, was a consistent feature. The significance of submediterranean species in the flora of *Festuco-Brometea* was even recognized by ROYER (1991) who divided the class into the suborders *Xerobromenalia* and *Mesobromenalia*, later validly described by BIONDI & *al.* (1995), on the basis, among other things, of differences in the per-

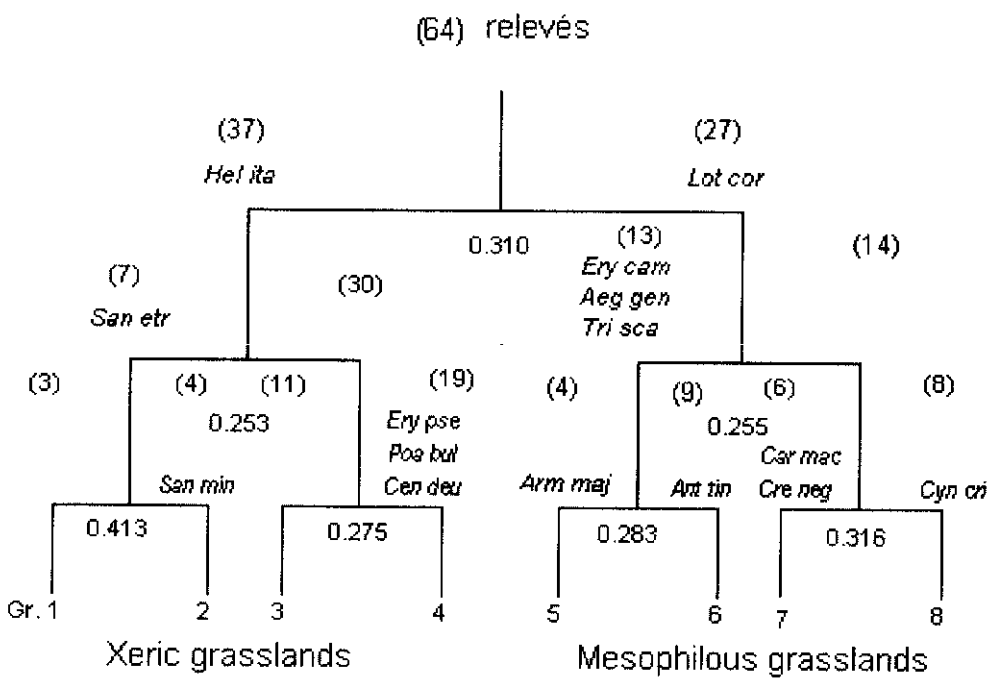

Figure 2.—Dendrogram obtained by divisive polythetic classification (TWINSPAN).

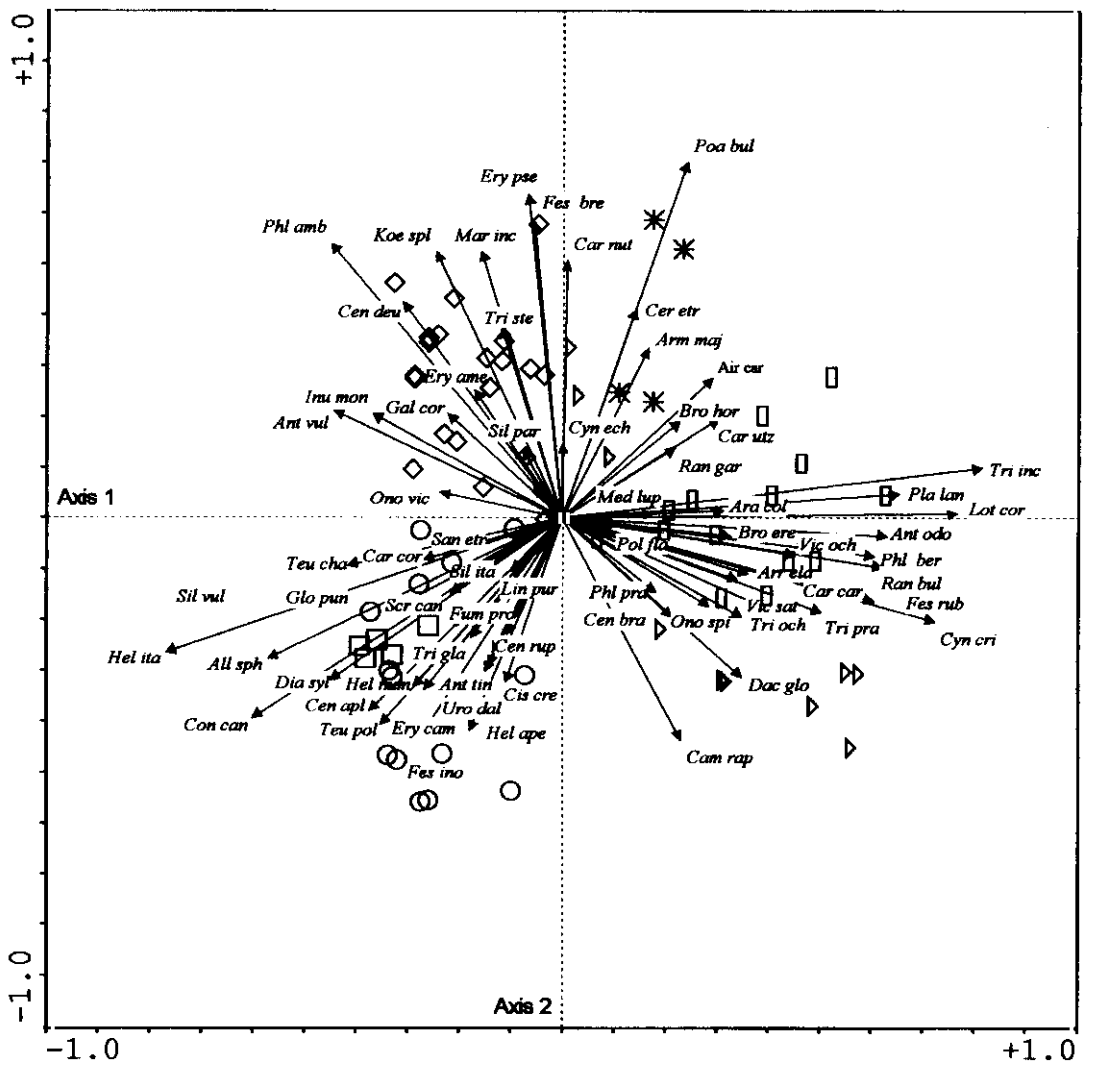

Figure 3.—Diagram of spread of relevés and species by PCA. Correspondences with groups (gps.) of the dendrogram: □ = gps. 1 and 2; ○ = gp. 3; ◇ = gp. 4; * = gp. 5; ▷ = gp. 6; ▯ = gps. 7 and 8.

centage of species with submediterranean distribution, which is greater in *Xerobromenalia*.

PCA axis 2 explained 7.9% of the total variance and was interpreted as an edaphic ecocline going from grasslands on eutrophic soils to those on nutrient-poor substrates. Indeed, along this axis we see a trend from oligotrophic to eutrophic species. The gradient expressed by axis 2 partly agrees with the second and third levels of division of the cluster.

The results of classification and ordination, together with floristic-sociological analysis, revealed two associations belonging to two suborders related to the main ecocline. These may be divided into two variants and into two subassociations and one variant, respectively, in relation to the gradient of

edaphic characteristics. The syntaxonomic scheme is as follows:

FESTUCO-BROMETEA ERECTI Br.-Bl. & Tuxen 1943 *ex* Klika & Hadac 1944
BROMETALIA ERECTI Br.-Bl. 1936
ARTEMISIO ALBAE-BROMENALIA ERECTI Biondi & *al.* 1995
Phleo ambigui-Bromion erecti Biondi *et* Blasi *ex* Biondi & *al.* 1995
Cerastio etrusci-Brometum erecti ass. nova
nitrophilous variant with *Poa bulbosa*
glareicolous variant with *Santolina etrusca*

LEUCANTHEMO VULGARIS-BROMENALIA ERECTI Biondi & *al.* 1995
Bromion erecti W. Koch 1926
Trifolio incarnati-Brometum erecti Oberdorfer &Hofmann 1967
phleetosum ambigui subass. nova
mesophilous variant with *Arrhenatherum elatius*
subnitrophilous variant with *Carlina corymbosa*
meso-xeric variant with *Armeria majellensis* ssp. *ausonia*

Cerastio etrusci-Brometum erecti *associatio nova* (*holotypus ass*: Table 3, rel. 5)

Structure: Mixed grasslands characterized by good floristic richness (mean 41 species per relevé), in which the dominant *Bromus erectus* is accompanied by other *Graminaceae* (*Koeleria splendens, Phleum ambiguum, Festuca inops, Melica ciliata, Dactylis glomerata*), by *Galium corrudifolium, Helichrysum italicum, Thymus longicaulis, Teucrium chamaedrys, Eryngium campestre* and by xerophytes such as *Allium sphaerocephalon, Centaurea deusta, Inula montana, Melica ciliata* and *Anthyllis vulneraria* ssp. *praepropera.*

The herbaceous layer ranges from moderately to quite dense (mean cover 74%) and is often discontinuous due to extensive areas of exposed rock. The structure is dominated by hemicryptophytes with a good percentage of geophytes and chamaephytes; therophytes are frequent but have limited cover, forming ephemeral patches in edaphoxerophilous calcicolous series (*Trachynietalia distachyae* and *Brometalia rubenti-tectorum*) in mosaics with the present grasslands. The presence of certain shrubs (phanerophytes and nanophanerophytes such as *Prunus spinosa, Spartium junceum, Acer monspessulanum*) indicates dynamic processes frequent in these areas due to reduced grazing pressure.

Synecology: These are xerophytic or semimesophytic pastures in the hill or low montane belt (700-1.180 m). They were present in all the studied sites, sometimes as the dominant type of pasture. They colonize slopes with basic lithosols that dry out completely in summer, and rocky sites where soil is confined to ledges exempt from widespread shrub colonization.

Morphology is characterized by inclinations of 5-35° and rockiness of 5-65%. Exposure is mostly in the southern quadrant.

Syndinamic: It concerns a formation of secondary character, connected to edaphon-xerophilous neutrobasophilous series whose mature stage is a mixed oak wood referred to *Lonicero-Quercion*. In addition, as a xerophilous grassland, it is connected to climatophilous series of *Quercus cerris* wood (*Melico-Quercetum cerridis*) or eutrophic beechwood with neutral to slightly acid soil (*Fagion sylvaticae*).

Synchorology: Boreal and mediterranean (*s.l.*) components are predominant and there is a strong endemic component (Figure 4).

Syntaxonomy: Good floristic homogeneity, an original contingent of species, distribution limited to basic lithosols and repetition of this type of vegetation on the present massifs make it possible to identify a new association which we call *Cerastio etrusci-Brometum erecti ass. nova* (*holotypus ass.*: Table 3, relevé 5, *hoc loco*). The characteristic com-

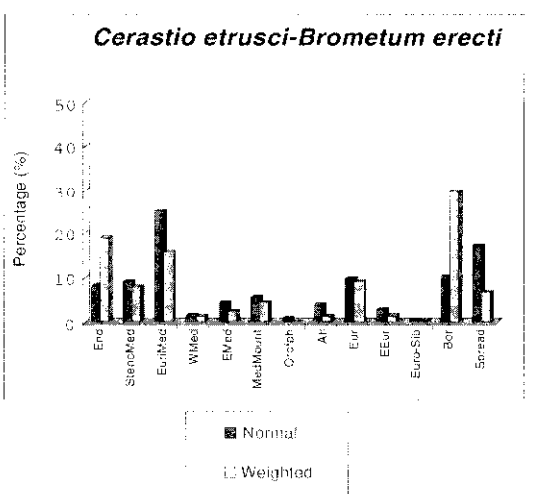

Figure 4.—Normal and weighted chorological spectra of the association *Cerastio etrusci-Brometum erecti.*

bination includes species growing in arid, stoney and/or rocky environments on limestone: *Cerastium arvense* ssp. *arvense* var. *etruscum* is a stenochorous endemism with distribution limited to arid and rocky environments on limestone of the Tuscan Apennine ridge (altitude 300-600 m) and on hill and montane reliefs of southern Tuscany (up to 1700 m on Mt. Amiata) (MICELI & *al.*, 1997; BECHI, 1998); *Festuca inops*, endemic to the northern and central Apennine in arid pastures; *Carlina corymbosa*, a species clearly linked with sheep grazing; *Convolvulus cantabrica*, a species with eurimediterranean distribution associated with xeric grasslands and garigue.

Within the association, two variants can be distinguished:

i) a nitrophilous variant with *Poa bulbosa* (Rels. 9-22 of Table 3) characterized by a greater abundance of ruderal elements, such as *Poa bulbosa*, which PIGNATTI (1982) indicates as linked to pioneer communities and as being grazing and trample-tolerant, *Carduus nutans* ssp. *macrolepis* and *Avena fatua*, both ruderal species. The variant is found in areas with extensive rocky outcrops with eroded material in the cracks, and is rich in ruderal and nitrophilous elements (which prosper on sheep manure).

ii) a glareicolous variant with *Santolina etrusca* (Rels. 23-28 of Table 3), found on certain massifs in the Amiata area, where this species, that prefers soils with a high clastic component, differentiates communities with a good suffruticose component in sites with stony, incoherent soil and some man-made disturbance, as shown by the constant presence of *Anthemis tinctoria*. There are many ecological affinities with *Asperulo purpureae-Brometum erecti* which includes discontinuous xerophytic grasslands of the hill belt on calcareous reliefs of the central Apennine (Marches and Umbria) on sunny slopes with relatively unevolved soils (BIONDI & BALLELLI, 1982, 1995; FRATTAROLI, 1988; VENANZONI & KWIATOWSKI, 1996; VENANZONI & GIGANTE, 1999), of which the new association can be regarded as western vicariant with mediterranean *s.l.* imprint. As observed in Table 4, *Asperulo purpureae-Brometum erecti* is differentiated by certain species with an eastern centre of gravity, not found on Antiapennine calcareous massifs of central-southern Tuscany. These species include: *Dianthus ciliatus*, a species with Antiadriatic distribution indicated in Tuscany only from the Apuan Alps (PIGNATTI, 1982), where recent data suggests that it was reported erroneously (FERRARINI & MARCHETTI, 1994); *Galium purpureum*, an orophyte with SE European distribution, known in Tuscany with the var. *typicum*, according to *herbarium* (FI and SIENA) and bibliographic data (FIORI, 1923-1929; PICHI SERMOLLI, 1948; RAFFAELLI & RIZZOTTO, 1991) only from the Arezzo area, the Pistoia pre-Apennine, the Garfagnana and Gorgona Island. *Cerastio etrusci-Brometum erecti* belongs to the alliance *Phleo-Bromion* (*Artemisio albae-Bromenalia erecti*, *Brometalia erecti*) by virtue of a large contingent of xerocalcicolous species widespread in, and/or endemic to, the central-southern Apennine. This alliance, which includes xerophytic and semimesophytic pastures, feels the influence of the Mediterranean region and is endemic to the hill and montane belts of the calcareous central-southern Apennine (with its ecological optimum in the hill bioclimatic zone), where it vicariates the central European alliance *Xerobromion* (ROYER, 1991; BIONDI & *al.*, 1995).

Trifolio incarnati-Brometum erecti Oberdorfer & Hofmann 1967 (Table 5)

Structure: Grasslands with continuous dense turf, quite rich in species (mean 41 per relevé) and cover of 80-100% (mean 92%). Physiognomy is determined by *Graminaceae* dominated by *Bromus erectus*, together with *Phleum bertolonii, Anthoxanthum odoratum* which may achieve high cover on decarbonated soils, *Dactylis glomerata*, and locally *Phleum ambiguum, Brachypodium rupestre, Festuca brevipila, Cynosurus cristatus* with many *Leguminosae* (*Lotus corniculatus, Trifolium incarnatum* ssp. *molinierii, T. pratense, T. ochroleucum, Vicia ochroleuca*). A good contingent of species which are differential of the class *Molinio-Arrhenatheretea* show the mesophilous character of these grasslands, and a good percentage of synanthropic species indicates previous agricultural land use.

The biological spectrum shows a clear prevalence of hemicryptophytes over therophytes and chamaephytes (the latter almost absent) indicative of mesophilous character. The presence and cover of phanerophytes and nanophanerophytes is low, consisting largely of seedlings of *Rubus ulmifolius, Rosa canina, Prunus spinosa* and *Crataegus monogyna*, precursors of woods confined to depressions and slopes with northern exposure (*Tilio-Acerion*) (MACCHERINI & *al.*, 2001).

Table 3

Cerastio etrusci-Brometum erecti associatio nova

(Phleo ambigui-Bromion erecti, Artemisio albae-Bromenalia erecti, Brometalia, Festuco-Brometea)

Locality	CG	Mce	Mce	Mce	Mce	CG	Mci	Mci	ML	MA	ML	Mci	ML	ML	ML	ML	ML	ML	ML	MB	MB	MA	MA	MA	MA	MA	MA	MA
Altitude (m a.s.l.)	750	820	770	750	800	700	1070	950	1170	1040	1030	1060	980	1010	1010	990	1130	980	920	1015	1025	820	870	890	920	890	910	930
Slope (°)	5	10	10	10	10	10	35	15	15	5	30	35	25	20	10	20	25	10	15	5	10	5	10	10	5	15	5	10
Aspect	WSW	SE	E	SW	ENE	SW	SW	S	E	S	O-SO	SSW	S-O	S	O-SO	E	S	S-E	S	SE	S	S-O	SO	SE	SE	SO	NE	S
Stoniness	10	20	5	10	10	5	35	10	60	10	60	40	5	20	40	50	45	40	65	10	10	10	5	5	5	10	30	20
Vegetation cover (%)	85	75	80	85	85	70	70	70	60	75	45	70	50	85	70	65	75	70	50	80	55	65	90	85	75	90	60	55
Plot Surface (sq. m)	25	25	30	25	30	15	6	16	20	10	25	6	25	40	45	25	25	20	20	25	30	30	15	15	20	20	15	20
Number of species	46	33	37	38	35	43	34	38	30	31	48	41	54	64	60	49	53	46	46	46	40	42	43	36	33	42	37	33
Relevé number	1	2	3	4	**5***	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Character and differential species of association																												
Festuca inops	1	1	1	1	+	2	2	1	2	1	1	+		2	1	1	1	1	1	–	1	+	1	.	+	+	1	.
Carlina corymbosa	2	.	+	+	1	2	.	1	.	.	1	2	+	+	+	1	2	1	+	+	1	2	2	1	.	1	.	.
Cerastium arvense ssp. *arvense* var. *etruscum*	+	.	+	+	+	.	+	+	1	+	1	+	.	.	+	+	1	+	1	.	.	.	.	+	.	.	+	+
Convolvulus cantabrica	+	2	.	2	1	1	+	.	.	.	.	1	+	.	1	+	.	.	+	.	.	.	2	2	2	+	+	+
Nitrophilous variant																												
Poa bulbosa	.	.	.	.	.	.	.	.	+	+	+	.	+	1	+	+	1	+	+	+	.	+	.	.	.	.	.	.
Avena barbata	+	.	.	.	.	.	.	.	.	.	1	2	1	2	2	+	+	+	+	.	.	1	.	.	.	.	.	.
Cardaus nutans ssp. *macrolepis*	.	.	.	.	.	.	.	.	+	.	.	.	.	1	+	+	+	+	2	+	+	1	.	+	.	.	.	.
Glareicolous variant																												
Anthemis tinctoria	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	1	+	+	+	+	1
Santolina etrusca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	1	2	1
Species of *Phleo-Bromion*																												
Phleum ambiguum	2	.	.	1	2	1	1	1	1	4	3	2	1	3	3	2	3	3	2	3	3	.	2	2	+	1	+	1
Erysimum pseudorhaeticum	.	.	.	+	+	.	2	+	+	+	2	+	+	1	1	1	+	1	1	+	+	.	+	1	+	+	.	+
Koeleria splendens	.	.	.	1	+	.	.	2	1	+	.	.	2	2	+	1	1	+	1	2	2	+	.	.	.	+	1	.
Centaurea deusta	.	.	.	.	.	.	1	+	+	+	1	2	1	+	+	.	.	1	.	.	.	.	.	.	+	.	1	.
Eryngium amethystinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	+	1	.	1	+	+
Hieracium piloselloides s.l.	.	.	–	.	.	+	.	.	.	.	.	.	+	1	1	.	.	.	.	.	.	+	.	.	.	.	.	.
Arabis collina	.	.	.	.	.	.	+	+	.	.	+	–	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Allium tenuiflorum	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.
Centaurea ambigua	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Armeria majellensis ssp. *ausonia*	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Centaurea triumfetti	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Leontodon cichoraceus	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Centaurea rupestris	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Silene otites	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Species of ***Artemisio albae-Bromenalia erecti***																												
Helichrysum italicum	2	1	+	2	1	1	1	2	.	2	.	1	1	+	+	1	1	+	+	.	+	.	2	1	2	2	2	2
Allium sphaerocephalon	+	1	+	2	+	+	.	+	+		+	.	.	.	+	.	.	1	+	+	+	1	+	1	+	r		1
Dianthus sylvestris ssp. *sylvestris*	1	+	+	+	1	+	.	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	.	.	.	1	.	+
Inula montana	.	+	.	+	+	.	+	.	1	.	.	.	+	+	2	.	1	2	.	.	1	.	.	.	.	.	.	.
Melica ciliata	+	.	.	.	.	.	+	.	+	1	+	1	.	.	.	+	+	.	.	.	.	.	.	.	.	1	1	.
Thesium divaricatum	.	+	1	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.
Teucrium polium ssp. *capitatum*	+	+		2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Crupina vulgaris	.	.	.	.	.	.	.	.	.	.	1	.	.	+	+	+	.	.	.	.	.	.	.	.	+	.	.	.
Linum tenuifolium	+	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Fumana procumbens	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Globularia punctata	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ononis pusilla	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helianthemum apenninum	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species of ***Brometalia, Festuco-Brometea***																												
Bromus erectus	4	4	4	3	4	3	2	3	3	2	3	3	3	3	3	4	3	2	2	3	2	2	2	+	2	4	2	2
Galium corrudifolium	+	1	+	1	+	+	2	1	+	+	1	1	1	+	1	2	+	1	1	+	2	+	1	.	+	2	+	1
Thymus longicaulis	.	+	+	1	1	1	3	2	2	+	+	+	+	+	+	+	1	+	1	2	1	1	.	.	.	2	1	+
Sanguisorba minor	+	1	1	1	1	+	1	+	1	+	.	+	+	1	+	+	.	+	+	1	1	.	.	.	+	+	+	+
Teucrium chamaedrys	+	+	.	1	1	+	+	+	.	2	1	+	1	+	1	1	.	1	+	.	.	2	2	2	3	1	.	1
Eryngium campestre	2	1	2	+	1	1	.	1	.	.	1	+	.	+	+	+	+	3	+	.	.	2	+	1	+	.	+	.
Plantago lanceolata var. *sphaerostachya*	.	.	+	+	.	+	.	.	+	.	1	.	+	.	+	+	.	+	1	1	+	.	.	+	+	.	+	.
Anthyllis vulneraria ssp. *praepropera*	+	.	.	1	+	.	.	1	.	1	+	+	1	1	+	+	.	1	.	.	.	.	.	.	1	+	+	.
Campanula rapunculus	+	+	+	.	.	+	.	+	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	+	.	.	.	.
Brachypodium rupestre	.	.	+	.	.	1	.	.	+	.	+	.	+	+	+	.	.	+	.	.	.	.	.	.	+	1	.	.
Trifolium campestre	+	+	+	.	.	+	.	.	.	.	+	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla hirta	.	+	+	.	.	.	.	.	.	.	.	.	.	+	2	.	1	+	.	.	.	.	+	.	+	.	.	.
Knautia purpurea	.	.	.	.	.	.	.	2	.	.	.	.	+	1	+	1	.	.	.	+	.	.	.	.	1	+	.	.
Trifolium incarnatum	.	.	.	.	.	.	.	1	+	.	+	.	.	.	.	+	.	+	.	1	.	+	.	.	.	.	.	.
Dianthus carthusianorum	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.	+	+	.	1	.	.	1	.	.
Onobrychis viciifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	+	1	+	1
Lotus corniculatus	.	.	+	.	.	.	.	+	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Hippocrepis comosa	.	.	2	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Hieracium pilosella	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.
Leontodon villarsii	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+
Polygala flavescens	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	+	.	.	.
Orchis coriophora ssp. *fragrans*	.	.	+	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trifolium ochroleucum	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Silene italica	.	.	+	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plantago lanceolata	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	.	.	.	.	+	.	.	.	.	.	.
Arabis hirsuta	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Odontites lutea	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helianthemum nummularium ssp. *oscurum*	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Medicago lupulina	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Centaurium erythraea	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Ononis spinosa
Achillea collina
Ranunculus bulbosus
Leopoldia comosa
Contacts with ***Trachynietalia dystachiae*** and ***Brometalia rubenti-tectorum***
Bupleurum baldense
Cynosurus echinatus
Crepis neglecta
Petrorhagia prolifera
Linum strictum
Carthanus lanatus
Trifolium scabrum
Alyssum minus
Trifolium stellatum
Medicago minima
Catapodium rigidum
Reichardia picroides
Aegilops geniculata
Bromus hordeaceus
Micropus erectus
Xeranthemum inapertum
Sideritis romana
Sherardia arvensis
Briza maxima
Arenaria serpyllifolia
Filago germanica
Valpia ciliata
Urospermum dalechampii
Acinos arvensis
Carduus pycnocephalus
Hypochoeris achyrophorus
Althaea hirsuta
Crepis vesicaria
Bromus sterilis
Anthemis arvensis
Crepis zacintha
Gastridium ventricosum
Trifolium angustifolium
Brachypodium distachyum
Coronilla scorpioides
Calamintha nepeta
Minuartia hybrida
Other species
Dactylis glomerata

Marrubium incanum	.	+	.	+	+	.	+	.	.	+	+	+	+	+	2	1	2	1	1	2	+	2	.	.	+	+	1	+
Echium vulgare	.	+	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	.	.	+	+	.	+	+	+	.	+	+
Sedum album	.	+	.	.	.	.	1	+	1	+	+	+	.	.	.	.	.	.	+	.	.	.	.	1	.	.	1	+
Hypericum perforatum	+	+	.	.	.	+	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	1	+	+	+	.
Orlaya grandiflora	1	.	.	.	.	.	.	.	.	+	1	.	+	1	2	.	+	1	+	.	.	.	.	.	.	.	.	.
Silene paradoxa	.	.	.	.	.	.	.	.	+	1	.	.	.	.	+	+	.	.	.	.	.	.	+	+	+	.	+	+
Scabiosa maritima	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	+	.	+	+	+	.	.	.	+	1	1
Sedum sexangulare	.	1	+	+	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.
Sedum rupestre	+	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	+	.	.	.	+	1	.	+	.	.
Cerastium luridum	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	+	1	+	+	.	.	.	.	.	.
Silene vulgaris ssp. vulgaris	+	.	.	+	.	1	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melica transsylvanica	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	+	.	.	.	+
Medicago sativa s.l.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	1	+	1	.
Xeranthemum cylindraceum	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	1
Spartium junceum	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	1
Daucus carota	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	+	.	+
Acinos alpinus	.	.	.	+	.	.	.	.	.	.	+	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.
Prunus spinosa	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+	.	.
Carduus micropterus	.	+	.	+	.	.	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phleum bertolonii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	+
Centaurea solstitialis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	+	.	.	.	.	.	.
Tragopogon porrifolius	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Potentilla detommasii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	1	.
Tragopogon samaritani	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Astragalus hamosus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	r
Bunium bulbocastanum	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Centaurea aplolepa ssp. *carueliana*	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scabiosa uniseta	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crupina crupinastrum	1	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lactuca virosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Scrophularia canina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.
Anthoxanthum odoratum	.	.	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Echinops siculus	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Rhinanthus alectorolophus	.	.	.	3	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stachys salviifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Convolvulus arvensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.
Cuscuta epithymum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.
Jasione montana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.
Sedum rubens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.
Sporadic species	5	1	4	0	2	2	1	0	1	1	2	4	3	1	4	1	3	1	2	4	3	3	4	2	1	3	4	1

Sporadic species: *Poa compressa, Tragopogon cfr. crocifolius* and *Trifolium ligusticum* +, *Carex flacca* and *Galactites tomentosa* 1 in 1; *Trinia glauca* ssp. *glauca* 1 in 2; *Cistus creticus* ssp. *eriocephalus, Lucula forsteri* and *Dorycnium pentaphyllum* ssp. *herbaceum* +, *Phleum pratense* 1 in 3; *Acer monspessulanum* (pl.) and *Orobanche caryophyllea* + in 5; *Vicia cracca* and *Euphorbia exigua* + in 6; *Hordeum leporinum* + in 7; *Armeria denticulata* 1 in 9; *Vulpia myuros* + in 10; *Verbascum lychnitis* and *Papaver rhoeas* + in 11; *Ranunculus garganicus, Asplenium onopteris, Geranium rotundifolium* and *Iris chamaeris* + in 12; *Picris echioides, Ophrys holoserica* and *Trifolium strictum* + in 13; *Pallenis spinosa* + in 14; *Asphodeline lutea, Colchicum lusitanum, Echium italicum* and *Sedum dasyphyllum* + in 15; *Geranium dissectum* + in 16; *Euphorbia helioscopia* and *Orobanche loricata* +, *Dasypirum villosum* 1 in 17; *Carex caryophyllea* + in 18; *Trifolium striatum* + and *Ruta graveolens* 1 in 19; *Medicago rigidula, Podospermum laciniatum and Rhinanthus minor* +, *Carlina lanata* 1 in 20; *Ornithogalum gr. umbellatum, Petrorrhagia velutina* and *Onobrychis caput - galli* + in 21; *Lolium perenne, Orobanche amethystea* and *Sisymbrium officinale* + in 22; *Tanacetum corymbosum* and *Crataegus monogyna* +, *Lathyrus sylvestris* and *Linaria purpurea* 1 in 23; *Andryala integrifolia* and *Vicia lutea* + in 24; *Holcus lanatus* + in 25; *Stachys germanica* and *Trigonella gladiata* +, *Vicia disperma* 1 in 26; *Rubus ulmifolius, Allium vineale, Trifolium cherleri* and *Trigonella gladiata* + in 27; *Rosa sempervirens* 1 in 28.

Localitieds and dates: 1, 6: Cornate di Gerfalco, Siena, Grosseto (06/07/2001); 2 - 5: Mt. Cetona, Siena (25/06/2001), *holotypus ass.* rel. 5; 7, 8, 12: Mt. Nebbiaio (Mt. Civitella), Grosseto (25/06/2001); 9, 17: Mt. Labbro, Grosseto (14/06/2000); 10, 26, 27: Mt. Aquilaia, Grosseto (19/06/2000); 11, 18, 22: Poggio Volturaie (Mt. Labbro), Grosseto (20/06/2000); 13 - 16: Poggio Pietriccione (Mt. Labbro), Grosseto (14/06/2000); 19: Pescinello Reserve, Grosseto (04/07/2000); 20, 21: Mt. Buceto (Mt. Labbro), Grosseto (12/06/2000); 23, 25: Pietra Sorbella (Mt. Aquilaia), Grosseto (30/06/1997); 24, 28: Pietra Sorbella (Mt. Aquilaia), Grosseto (07/07/1997).

Table 4
Synoptic table comparing the association *Cerastio etrusci-Brometum erecti* with some related communities.
Values in bold indicate character and differential species of association; other species with only one presence are not reported

No of relevés	29	19	20
Relevé group	A	B	C
Character and differential species of association			
Festuca inops	**V**	.	.
Carlina corymbosa	**IV**	.	.
Convolvulus cantabrica	**III**	**II**	
Cerastium arvense ssp. *arvense* var. *etruscum*	**III**	.	.
Allium sphaerocephalon	IV	**III**	V
Eryngium amethystinum	II	**V**	**V**
Crepis lacera	I	**III**	**IV**
Dianthus ciliatus	.	**III**	.
Asperula purpurea	.	**V**	V
Cerastium arvense ssp. *suffruticosum*	.	**I**	**IV**
Leontodon crispus	.	.	**V**
Alyssum montanum	.	.	**V**
Potentilla rigoana	.	.	**IV**
Teucrium montanum	.	.	**V**
Species of *Phleo-Bromion:*			
Phleum ambiguum	V	III	V
Erysimum pseudorhaeticum	IV	III	V
Koeleria splendens	III	III	IV
Centaurea ambigua	I	I	V
Silene otites	I	II	II
Onosma echioides	.	I	II
Thymus striatus	.	V	I
Muscari atlanticum	.	I	II
Helianthemum canum	.	III	V
Allium tenuiflorum	**I**	I	.
Centaurea triumfetti	**I**	.	V
Centaurea deusta	**III**	.	.
Hieracium piloselloides s.l.	II	.	.
Arabis collina	I	.	.
Armeria majellensis	I	.	.
Leontodon cichoraceus	I	.	.
Centaurea rupestris	I	.	.
Trinia dalechampii	.	I	.
Species of *Artemisio albae-Bromenalia erecti:*			
Dianthus sylvestris	III	III	V
Melica ciliata	II	II	I
Thesium divaricatum	II	IV	I
Linum tenuifolium	I	II	III
Fumana procumbens	I	IV	II
Globularia punctata	I	II	II
Helianthemum apenninum	I	II	.
Petrorhagia saxifraga	**I**	**IV**	.
Stachys recta	**I**	**IV**	.
Argyrolobium zanonii	.	I	III
Artemisia alba	.	IV	V
Coronilla minima	.	IV	III
Satureja montana	.	IV	V
Helichrysum italicum	V	.	.
Inula montana	II	.	.
Teucrium polium ssp. capitatum	I	.	.
Crupina vulgaris	**I**	.	.
Ononis pusilla	**I**	.	.
Species of *Brometalia, Festuco-Brometea*			
Bromus erectus	V	V	V
Sanguisorba minor	V	III	V
Thymus longicaulis	V	IV	V
Teucrium chamaedrys	IV	V	V
Eryngium campestre	IV	I	I
Anthyllis vulneraria ssp. *praepropera*	III	II	I
Brachypodium rupestre	II	V	V

Table 4 (continuación)
Synoptic table comparing the association *Cerastio etrusci-Brometum erecti* with some related communities.
Values in bold indicate character and differential species of association; other species with only one presence are not reported

No of relevés	29	19	20
Relevé group	A	B	C
Knautia purpurea	II	IV	V
Lotus corniculatus	II	II	V
Hippocrepis comosa	I	IV	III
Hieracium pilosella	I	IV	V
Arabis hirsuta	I	III	II
Helianthemum nummularium ssp. *oscurum*	I	I	III
Carex caryophyllea	I	II	IV
Carlina utzka	I	III	V
Onobrychis viciifolia	I	II	.
Medicago lupulina	I	I	.
Orobanche purpurea	.	I	II
Campanula glomerata	.	I	I
Asperula cynanchica	.	II	IV
Galium corrudifolium	V	.	.
Plantago lanceolata var. sphaerostachya	IV	.	.
Campanula rapunculus	III	.	.
Trifolium campestre	II	.	.
Potentilla hirta	II	.	.
Trifolium incarnatum	II	.	.
Scabiosa columbaria	.	II	.
Lactuca perennis	.	II	.
Ophrys apifera	.	I	.
Carlina vulgaris	.	I	.
Orchis morio	.	.	I
Galium verum	.	.	I
Euphorbia cyparissias	.	.	I
Contact with *Trachynietalia distachyae* and *Brometalia rubenti-tectorum*			
Bupleurum baldense	IV	.	.
Cynosurus echinatus	IV	.	.
Crepis neglecta	III	.	.
Trifolium scabrum	III	.	.
Carthamus lanatus	III	.	.
Linum strictum	III	.	.
Alyssum minus	III	.	.
Xeranthemum inapertum	II	.	.
Trifolium stellatum	III	.	.
Petrorhagia prolifera	III	.	.
Medicago minima	II	.	.
Aegilops geniculata	II	.	.
Bromus hordeaceus	II	.	.
Catapodium rigidum	II	.	.
Reichardia picroides	II	.	.
Micropus erectus	II	.	.
Sideritis romana	II	.	.
Filago germanica	II	.	.
Sherardia arvensis	II	.	.
Other species	.	.	.
Dactylis glomerata	V	IV	II
Sedum album	III	I	III
Sedum rupestre	II	III	IV
Acinos alpinus	I	II	III
Spartium junceum	I	II	.
Digitalis lutea	.	I	IV
Festuca sp.	.	III	II
Festuca rubra aggr.	.	I	V
Sedum acre	.	III	V
Marrubium incanum	IV	.	.
Orlaya grandiflora	III	.	.
Hypericum perforatum	III	.	.
Poa bulbosa	III	.	.
Carduus nutans ssp. *macrolepis*	II	.	.

Table 4 (continuación)
Synoptic table comparing the association *Cerastio etrusci-Brometum erecti* with some related communities.
Values in bold indicate character and differential species of association; other species with only one presence are not reported

No of relevés	29	19	20
Relevé group	A	B	C
Avena barbata	II	.	.
Santolina etrusca	II	.	.
Echium vulgare	II	.	.
Anthemis tinctoria	II	.	.
Sedum sexangulare	II	.	.
Silene paradoxa	II	.	.
Cerastium luridum	II	.	.
Silene vulgaris ssp. *vulgaris*	II	.	.
Scabiosa maritima	II	.	.

Relevé source: A. Cerastio etrusci-Brometum erecti; B. Asperulo purpureae-Brometum erecti (Table 1 in Biondi & Blasi, 1982); C. Asperulo purpureae-Brometum erecti teucrietosum montani (Table 1 in Biondi & Blasi, 1982).

Synecology: Mesophytic grasslands distributed essentially in the low montane belt (850-1.150 m). In the study area their distribution is limited and fragmented, relegated to the few fertile areas not yet invaded by shrubs and nitrophiles such as *Sambucus ebulus*. They develop mostly in areas of soil accumulation, often on moderately to very deep colluvial soils that remain moist for most of the year and have low rockiness (5-20%), in flat or gently sloping (5-15°) sites. Exposures are mainly in the northern and eastern quadrants.

Synchorology: The boreal *s.l.* contingent predominates, followed by eurimediterranean contingents; species with wide distribution have a considerable weight (Figure 5).

Syndinamic: It concerns a formation, at 800m a.s.l., of secondary character connected to climatophilous series of *Quercus cerris* wood on deep, fertile, slightly acid soil usually linked to a weak slope morphology (*Melico-Quercetum cerridis*) and at higher altitudes to an eutrophilous beechwood of the climatophilous series with neutral to slightly acid soil (*Fagion sylvaticae*).

Syntaxonomy: By virtue of their synecology and composition, we classify these communities in *Trifolio incarnati-Brometum erecti* Oberdorfer & Hofman 1967, present in the Ligurian Apennine where it colonizes soils up to moderate depth in flat areas of the submediterranean and montain belt (Oberdorfer & Hofmann, 1967; Nowak, 1987) and reported in Tuscany from the Casentine by Vos & Stortelder (1992). The species characteristic of the association found in the study area are *Trifolium incarnatum* ssp. *molinierii*, *Campanula rapunculus*, *Cerastium ligusticum*, *Festuca rubra* agg. and *Lathyrus latifolius*. However, the presence of a good component of species such as *Phleum ambiguum*, *Koeleria splendens*, *Erysimum pseudorhaeticum*, *Arabis collina*, *Eryngium amethystinum*, characteristic of the endemic Apenninic alliance *Phleo ambigui-*

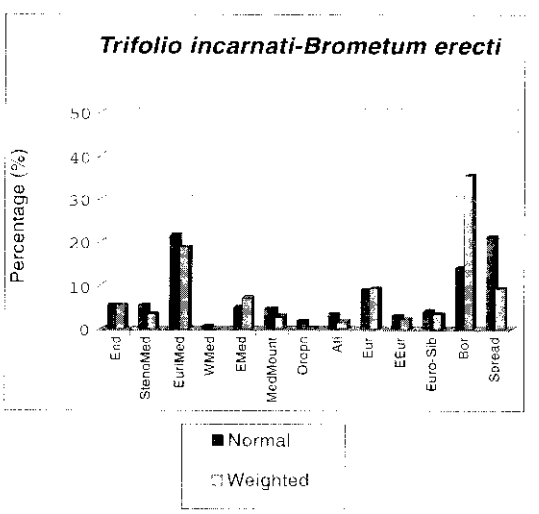

Figure 5.—Normal and weighted chorological spectra of the association *Trifolio incarnati-Brometum erecti pleetosum ambigui*.

Bromion erecti, suggests differentiation of a new «Antiapenninic» subassociation called *phleetosum ambigui* (*holotypus subass.*: Table 5, relevé 3, *hoc loco*).

In the area examined, this subassociation showed at least three groups in relation to physical characteristics of soil and pedogenesis:

i) a mesophilous variant with *Arrhenatherum elatius* (Rels. 1-8 of Table 5) (indicated by OBERDORFER & HOFMANN (1967) as subassociation *arrhenatheretosum elatioris* and later by NOWAK (1987) as a variant) differentiated by *Arrhenatherum elatius* and *Trifolium ochroleucum*. This variant includes strongly mesophilous grasslands, rich in transgressive species of the class *Molinio-Arrhenatheretea*, that establish on deep mature soils which retain moisture throughout the year; they show floristic and ecological affinity with central European *Arrhenatherum* grasslands;

ii) a subnitrophilous variant with *Carlina corymbosa* and other differential species such as *Ononis spinosa* and *Medicago lupulina* (rels. 9-19 in Table 5); it includes vegetation related to grazing, on soils with a high clay component that well retain moisture but are compact and xeric in summer, as shown by the frequency of species of *Trachynietalia* and *Brometalia rubenti-tectorum*, the presence of which, however, remains sporadic;

iii) a meso-xeric variant with *Armeria majellensis* ssp. *ausonia* (Rels. 20-23 in Table 5); it includes communities linked to steeper slopes, less evolved soil and high rockiness; it is impoverished in species characteristic of the association and mesophilous species; this variant probably marks a transition towards xeric pasture vegetation.

The association is classified by the authors in *Bromion* (*Leucanthemo vulgaris-Bromenalia erecti*), which in the northern and central Apennines includes associations that develop on heavy soils and is common in mesic sites. It replaces communities of the alliance *Cynosurion cristati*, which have fragmented distribution (MACCHERINI & *al.*, 2001), since, as reported by OBERDORFER & HOFMAN (1967), summer drought limits their production and only enables richer fields with *Arrhenatherum elatius* to form locally. Indeed, mostly western submediterranean species have been indicated as characteristic, and these species differentiate Apennine vegetation (which the authors indicate as *Mesobrometum apenninum*) from central European *Bromus* grasslands.

With respect to other grasslands of the order *Brometalia*, the association is also characterized by a large contingent of synanthropic species that indicate previous agricultural land use; indeed, we found evidence that sufficiently flat land had been cultivated from above the altitude of the chestnut woods to the ridges (TABET, 1936).

In Table 6 it can be seen that there exists little, if any, affinity with the other associations of the alliance *Bromion* identified in central-southern Tuscany, due to large differences in flora which depend essentially on edaphic factors (clayey or marly-arenaceous soils); there is also a lack of floristic affinity, probably due to the relatively low altitudes of our areas, with the association *Brizo mediae-Brometum erecti* which includes continuous mesophilous grasslands on calcareous substrates but is associated with summit sectors of the central Apennine (BRUNO & COVARELLI, 1968; BIONDI & BALLELLI, 1982; VENANZONI & GIGANTE, 1999).

CONCLUSIONS

The present study enabled the identification of two main types of grasslands: *Cerastio etrusci-Brometum erecti* and *Trifolio incarnati-Brometum erecti*. They are divided into syntaxa of lower rank, markedly differentiated in floristic composition and structure in relation to soil chemical and physical characteristics and degree of pedogenesis. Our results indicate that the main factors for the syntaxonomic collocation of *Brometalia* grasslands, both mesophilous and xerophilous, are soil factors. This is in line with the findings of ROYER (1985). However, in our opinion, chorological analysis and especially the role of the endemic element, which becomes fundamental for xeric vegetation, are important for the synsystematics of grasslands.

We also confirmed the presence of xerophilous grasslands of the alliance *Phleo-Bromion* in central-southern Tuscany, where they form disjunct areas in the distribution of this *syntaxon*. All this demonstrates the strong historical, biogeographic and floristic link between the calcareous massifs of the central-southern Apennine, indicating past contact between Balkan-Apennine and Illyrian flora and the Tyrrhenian peninsular flora (MAZZESCHI & SELVI, 1999).

Table 5

Trifolio incarnati - Brometum erecti Oberdorfer & Hoffman 1967 *phleetosum ambigui* subass. nova (*Bromion erecti, Leucanthemo vulgaris-Bromenalia erecti, Brometalia, Festuco-Brometea*)

Locality	MA	MB	MB	MB	ML	ML	ML	ML	ML	ML	ML	MB	Mci	ML	ML	ML	ML	MB	MB	MB	MB	ML
Altitude (m a.s.l.)	1005	1140	1150	1170	1020	980	1140	1020	950	930	1000	1040	950	975	965	875	800	985	1150	1160	1160	1180	1120
Slope (°)	5	5	7	5	5	<5	10	5	10	5	15-20	15	15	5	<5	5	<5	5-10	10	15	5	15	15
Aspect	E	S-SO	O	O-NO	O	N-NE	N-NO	N	E	E	N-NE	S-E	SE	S	O	E	S	N-E	S-SE	O	S-O	NO	N-O
Stoniness (%)	0	3	5	5	5	2	0	0	10	15	5	5	0	5	0	0	0	0	5	5	25	25	5
Vegetation cover (%)	100	100	95	95	90	100	100	98	90	80	80	95	80	95	95	80	100	100	95	95	85	80	90
Plot surface (sq. m)	35	20	20	10	10	20	10	20	25	15	30	35	15	20	30	15	35	35	40	40	25	15	10
Number of species	46	48	41	37	42	36	34	34	57	37	32	44	40	53	50	48	59	45	50	46	51	46	31
Relevé number	1	2	3*	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Character and differential species of association																							
Trifolium incarnatum ssp. molinieri	4	2	2	1	2	1	2	+	+	+	+	2	2	1	3	.	2	3	3	2	2	2	2
Cerastium ligusticum	+	2	2	1	1	1			1	1	+			1	1	1	+	+	1	2	2	1	.
Campanula rapunculus	.	+	+	.	+	.	+	+	+	+	.	+	+	+	+	.	+	+	+	.	.	.	+
Festuca rubra agg.	1	1	1	2	.	.	1	.	.	.	.	.	.	.	1	.	.	2	+	.	.	.	2
Lathyrus latifolius	.	.	.	.	+	.	.	.	.	.	+	.	.	.	+	.	.	+	.	.	.	.	.
Diferential species of ***phleetosum ambigui***																							
Erysimum pseudorhaeticum	.	+	+	.	+	+	.	.	.	+	+	+	+	+	+	.	.	+	2	.	+	1	+
Phleum ambiguum	.	1	1	2	2	+	2	+	+	.	3	.	+	.	.	.	.	.	.	.	2	3	2
Arabis collina	+	.	.	+	.	+	.	.	+	.	+	.	+	.	+	+	+	+	.	.	+	.	.
Koeleria splendens	.	.	+	+	+	.	.	.	+	+	.	.	1	.	.	.	.	.	.	.	2	.	.
Eryngium amethystinum	.	2	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2	1	.
Mesophilous variant																							
Trifolium ochroleucum	3	1	1	2	+	3	.	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Arrhenatherum elatius	.	+	+	+	.	.	2	1															
Subnitrophilous variant																							
Carlina corymbosa	.	1	+	.	.	.	.	.	2	3	.	1	2	2	+	+	+	.	.	.	+	.	.
Ononis spinosa	+	.	.	.	.	.	.	.	1	+	.	.	1	.	2	3	1	+	+	.	.	.	+
Medicago lupulina	.	.	.	.	.	.	.	.	+	.	+	+	.	+	+	.	.	1	.				
Meso-xeric variant																							
Armeria majellensis ssp. *ausonia*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	+	1
Species of ***Bromion erecti*** and ***Leucanthemo vulgaris-Bromenalia erecti***																							
Lotus corniculatus	1	1	1	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	2	+	+	+

Dactylis glomerata	.	1	1	.	+	1	3	1	2	1	+	1	+	1	2	2	2	3	1	.	.	.	1
Plantago lanceolata	1	+	+	+	+	+	.	.	+	+	+	+	.	.	+	.	1	+	+	.	+	.	.
Ranunculus bulbosus	+	1	.	1	.	1	1	1	+	.	.	.	.	+	+	.	+	+	+	.	.	.	1
Carex caryophyllea	2	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhinanthus alectorolophus	.	.	.	.	.	3	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+
Daucus carota	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.
Centaurea bracteata	1	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leucanthemum gr. vulgare	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linum catharticum ssp. *catharticum*	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polygala vulgaris	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhinanthus minor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Centaurium erythraea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Blackstonia perfoliata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Gymnadenia conopsea	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Species of ***Brometalia erecti*** and ***Festuco-Brometea***																							
Bromus erectus	4	3	4	3	4	4	3	3	4	2	3	4	4	4	4	3	4	3	4	2	3	4	4
Sanguisorba minor	+	+	+	+	1	+	.	1	+	1	+	.	+	+	1	1	1	+	+	+	1	.	1
Knautia purpurea	+	1	1	+	.	1	+	2	1	.	1	1	1	+	.	+	1	+	+	+	+	2	+
Thymus longicaulis	+	+	.	+	1	+	.	+	2	1	3	1	1	+	.	2	.	.	1	1	+	2	1
Galium corrudifolium	+	1	+	.	1	1	.	.	+	+	+	2	+	.	1	.	.	+	1	+	2	+	1
Brachypodium rupestre	2	.	2	1	+	.	+	1	2	.	.	2	1	+	+	.	+	1	.	.	.	.	+
Eryngium campestre	.	.	.	.	.	+	.	+	2	1	+	+	2	2	+	+	1	+	.	.	.	.	.
Cerastium arvense ssp. arvense var. etruscum	.	+	+	2	+	.	1	+	.	+	.	+	+	.	.	.	.	.	+	.	+	1	.
Teucrium chamaedrys	.	.	+	.	+	1	.	+	.	.	+	.	+	.	.	+	.	.	1	.	+	1	1
Trifolium campestre	+	+	.	.	+	.	.	.	+	+	.	+	.	+	+	+	+	+	.	.	.	.	.
Stachys salviifolia	.	+	1	2	.	1	.	.	1	.	+	2	.	+	.	.	.	.	.	.	1	1	.
Marrubium incanum	.	.	.	.	.	+	.	.	.	2	.	.	+	1	.	.	+	.	1	+	+	+	.
Achillea collina	.	1	.	+	.	.	3	1	.	.	+	.	+	.	.	.	1	.	1	1	.	.	.
Galium verum	.	2	1	.	.	.	.	.	.	.	.	.	.	+	.	.	1	.	.	+	+	+	.
Trifolium pratense	.	.	.	.	.	.	.	.	+	.	.	+	.	+	+	.	+	2	+	.	.	.	.
Anthemis tinctoria	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	+	+	+	.	.	.	.	.
Dianthus carthusianorum	.	.	.	.	.	.	.	.	+	+	.	+	+	.	+	.	.	.	.	+	.	.	.
Saxifraga bulbifera	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
Potentilla hirta	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Hieracium pilosella	.	+	.	.	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	+	.	.
Anthyllis vulneraria ssp. praepropera	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	+
Carlina utzka	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+
Cuscuta epithymum	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Plantago lanceolata	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	+	.
Polygala flavescens	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Hieracium pilosselloides s.l.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.
Dianthus sylvestris ssp. sylvestris	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Festuca inops	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Allium sphaerocephalon	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.

Contacts with ***Agropyretalia*** and ***Molinio-Arrhenateretalia***																									
Phleum bertolonii	+	+	.	.	1	2	+	.	1	.	.	2	.	2	+	2	1	2	.	1	+	+	+		
Anthoxanthum odoratum	2	2	2	.	2	3	+	2	.	.	1	.	+	.	2	+	2	+	.	.	3	1	1		
Cynosurus cristatus	2	4	1	3	.	+	1	.	.	1	.	.	.	+	3	+	3	2	+	1	.	.	+		
Lolium perenne	.	+	.	.	.	.	1	.	+	+	.	.	.	1	1	+	1	.	2	3	+	+	.		
Bromus hordeaceus	.	+	.	.	+	+	+	.	.	+	.	.	.	+	+	.	1	.	1	2	+	.	.		
Festuca arundinacea	+	.	1	.	.	.	.	3	+	.	.	.	.	1	.	+	1	2	.	.	.	.	.		
Agrostis tenuis	.	.	.	.	.	.	.	.	+	.	+	+	.	1	.	.	+	+	.	.	.	.	.		
Convolvulus arvensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	+	.	.	.		
Picris hieracioides	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	.	+	+	.	.	.	.	.		
Poa compressa	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	1	.	.	.	.	.		
Ornithogalum gr. umbellatum	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	.		
Holcus lanatus	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.		
Xeranthemum cylindraceum	1	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Rumex acetosa	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.		
Contact with ***Trachynietalia dystachiae*** and ***Brometalia rubenti-tectorum***																									
Bupleurum baldense	.	+	+	+	+	+	+	.	+	+	+	+	+	+	+	+	.	.	.	+	+	+	+		
Cynosurus echinatus	+	+	+	+	+	+	.	.	+	+	.	+	1	+	+	+	+	+	.	+	1	.	.		
Petrorhagia prolifera	+	+	+	+	+	+	.	.	.	+	.	+	+	+	.	+	+	.	+	+	.	.	.		
Crepis neglecta	.	.	.	.	+	.	.	.	+	+	.	+	+	1	.	+	+	.	+	+	+	+	+		
Linum strictum	.	.	.	.	+	.	.	.	+	+	.	1	+	.	.	+	.	+	.	.	+	.	.		
Trifolium scabrum	.	.	.	.	.	.	.	.	+	+	+	+	.	+	+	+	.	.	.	.	.	.	.		
Aegilops geniculata	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	+	+	.	1	.	.	.	.		
Trifolium stellatum	.	.	.	.	.	.	.	.	1	+	.	+	+	+	.	+	.	.	.	.	.	.	.		
Carduus pycnocephalus	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	+	.	+	+	.	.	.		
Medicago minima	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	+	+	.	.	.	.	.	.		
Arenaria serpyllifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	+	.		
Trifolium angustifolium	.	.	.	.	.	.	.	.	+	.	.	+	.	−	.	+	.	.	.	.	.	.	.		
Alyssum minus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.		
Avena barbata	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.		
Crepis vesicaria	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.		
Aira caryophyllea ssp. *caryophyllea*	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.		
Micropus erectus	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.		
Filago germanica	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.		
Hypochoeris achyrophorus	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.		
Crepis zacintha	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.		
Euphorbia exigua	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.		
Other species																									
Poa annua var. vivipara	.	+	.	+	+	+	+	.	+	+	1	+	.	.	.	.	.	.	+	1	+	1	+		
Sherardia arvensis	.	+	.	.	+	+	.	.	+	+	.	.	+	1	+	+	+	+	+	+	+	.	.		
Poa sylvicola	.	1	1	+	.	2	1	.	+	.	.	+	.	1	+	.	+	+	3	3	.	+	.		
Orlaya grandiflora	.	.	.	.	.	+	+	.	+	.	.	+	.	+	1	.	+	+	1	.	+	1	+		
Festuca brevipila	.	+	.	.	1	.	.	.	1	1	2	1	.	.	.	.	.	.	.	+	1	2	1		
Tragopogon samaritani	.	.	.	.	+	.	.	1	+	.	+	+	+	.	+	.	.	.	+	.	+	.	.		
Vicia sativa	.	+	.	.	.	.	.	.	+	.	+	.	.	+	+	.	.	+	.	+	.	.	+		

Carthamus lanatus	.	.	+	.	+	.	.	.	+	+	.	.	+	1	.	.	+	.	1	.	.	.	.
Bunium bulbocastanum	.	1	+	.	1	.	.	+	.	.	.	.	.	.	1	.	.	.	+	+	+	.	.
Vicia ochroleuca	2	1	2	+	.	2	.	2	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.
Geranium columbinum	.	.	+	1	.	+	.	+	+	.	.	.	.	.	.	.	+	.	.	+	.	+	.
Carduus nutans ssp. macrolepis	.	+	.	.	+	.	.	.	.	+	.	.	.	+	.	.	.	.	.	+	+	+	.
Luzula campestris	+	1	1	2	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Sedum sexangulare	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	+	+	.	+	+
Silene paradoxa	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+
Prunus spinosa	.	+	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.
Centaurea solstitialis	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	+	.	.	.	.
Leontodon cichoraceus	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	.	.
Xeranthemum inapertum	.	.	.	.	+	.	.	.	.	.	.	+	.	.	+	.	.	1	.	.	.	.	.
Ranunculus garganicus	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+	1	.
Echium vulgare	.	.	.	.	.	+	.	.	+	.	.	.	.	+	.	+	.	.	.	.	.	.	.
Cirsium tenoreanum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+	+	+	.	.	.
Geranium molle	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
Medicago sativa s.l.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.
Dasypyrum villosum	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Hypericum perforatum	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Scabiosa maritima	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	.
Rubus ulmifolius	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.
Capsella bursa-pastoris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
Echinops siculus	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Silene vulgaris ssp. vulgaris	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.
Tragopogon porrifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.
Allium tenuiflorum	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.
Calamintha nepeta	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.
Allium sp.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Orchis sp.	1	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phleum pratense	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	2	.	.	.	.
Torilis arvensis ssp. purpurea	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Petrorhagia velutina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.
Rumex acetosella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
Agrostis castellana	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Cruciata glabra	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Delphinium fissum	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Gaudinia fragilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.
Lathyrus hirsutus	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Ornithogalum pyramidale	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.
Pteridium aquilinum	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola etrusca	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Sporadic species: *Euphrasia stricta* in 1; *Agrimonia eupatoria*, *Valerianella eriocarpa* and *Picris echioides* + in 3; *Sedum rupestre* + in 6; *Agrostis stolonifera* 2, *Armeria denticulata* + in 7; *Allium vineale* + in 8; *Althaea hirsuta* + in 9; *Carduus micropterus* and *Silene italica* + in 13; *Anagallis arvensis* + in 14; *Acinos arvensis* and *Leontodon villarsii* + in 15; *Leopoldia comosa*, *Cynoglossum creticum*, *Tragopogon pratensis* ssp. *pratensis*, *Tragopogon pallidum* and *Hippocrepis comosa* + in 16; *Vicia bithynica* 2, *Stachys heraclea*, *Onobrychis caput-galli* and *Cichorium intybus* + in 17; *Potentilla reptans* + in 18; *Vicia cracca*, *Thlaspi perfoliatum* and *Rosa canina* + in 19; *Veronica arvensis*, *Bromus sterilis* and *Galium album* + in 20; *Inula montana*, *Carlina lanata*, *Vulpia bromoides*, *Bromus madritensis* and *Crupina vulgaris* + in 21; *Sedum album*, *Acinos alpinus*, *Knautia integrifolia* and *Papaver argemone* +, *Centaurea deusta* 1 in 22.

Locality and date: 1: Pietra Rossa (Mt. Aquilaia), Grosseto (19/06/2000); 2 - 4, 12, 19 - 22: Mt. Buceto (Mt. Labbro), Grosseto (12/06/2000) *holotypus subass.* rel. 3; 5, 9, 11, 14, 16: Poggio la Sassaiola (Mt. Labbro), Grosseto (20/06/2000); 7, 18, 23: Mt. Labbro, Grosseto (14/06/2000); 17: Pescinello Reserve (Mt. Labbro), Grosseto (04/07/2000); 10, 15: Poggio Volturaie (Mt. Labbro), Grosseto (20/06/2000); 6, 8: Poggio Pietriccione (Mt. Labbro), Grosseto (14/06/2000); 13: Mt. Nebbiaio (Mt. Civitella).

Table 6

Synoptic table comparing the association *Trifolio incarnati-Brometum erecti phleetosum ambigui* with some related communities. Values in bold indicate character and differential species of association; other species with only one presence are not reported

No. of relevés	24	9	24	9	18	7	13
Relevé group	A	B	C	D	E	F	G
Character and differential species of association							
Trifolium incarnatum ssp. *molinieri*	V	III	II	I	.	.	I
Campanula rapunculus	IV	III	I	III	.	.	.
Cerastium ligusticum	IV	.	II	II	.	.	.
Festuca rubra aggr.	II	.	V	V	.	.	V
Lathyrus latifolius	I	.	III	IV	.	.	.
Koeleria splendens	II	.	.	.	III	II	I
Arabis collina	III	.	.	.	.	.	I
Phleum ambiguum	III	.	.	.	.	.	I
Erysimum pseudorhaeticum	IV	.	.	.	.	.	.
Eryngium amethystinum	III	.	.	.	.	.	.
Polygala nicaeensis	.	IV	V	V	.	.	.
Trisetum flavescens	.	III	V	IV	.	.	.
Hypochoeris radicata	.	II	III	III	.	.	.
Moenchia mantica	.	IV	.	II	.	.	.
Danthonia alpina	.	.	II	II	.	.	.
Thymus pulegioides	.	.	II	III	.	.	.
Aster linosyris	.	.	.	.	IV	V	.
Seseli tortuosum	.	.	.	.	V	.	.
Anacamptis pyramidalis	.	.	I	.	III	.	.
Scabiosa maritima	I	.	.	.	II	IV	.
Polygala flavescens	I	.	.	.	I	IV	.
Plantago maritima	.	.	.	.	.	III	.
Doryenium penthaphyllum ssp. *herbaceum*	.	.	.	.	I	II	.
Pseudolysimachion barrelieri	.	.	.	.	.	I	.
Stachys officinalis	.	.	.	.	.	II	III
Luzula multiflora	.	.	.	.	.	.	V
Filipendula vulgaris	.	.	.	.	.	.	II
Species of *Bromion erecti, Leucanthemo vulgaris-Bromenalia erecti*							
Bromus erectus	V	V	V	V	V	V	V
Plantago lanceolata	IV	IV	V	III	III	IV	III
Ranunculus bulbosus	III	III	V	IV	I	I	.
Centaurea gr. iacea	I	II	I	II	I		.
Blackstonia perfoliata	I	.	I	.	IV	IV	.
Gymnadenia conopsea	I		I		I		II
Orchis morio	.	III	IV	IV	.	.	I
Ononis spinosa s.l.	III	IV	IV	.	.	III	.
Onobrychis viciifolia	.	IV	.	.	.	I	I
Carex flacca	.	.	II	.	IV	II	.
Koeleria pyramidata	.	III	I	.	.	.	.
Scabiosa columbaria	.	II	I	.	.	.	.
Orchis coriophora	.	I	.	.	.	II	.
Orchis mascula	.	II	.	.	.	.	III
Plantago media	.	III	.	.	.	.	I
Trifolium montanum	.	IV	.	.	.	.	III
Astragalus monspessulanus	.	.	I	.	I	.	.
Prunella laciniata	.	.	.	.	I	.	II
Satureja montana	.	.	.	.	III		I
Orchis tridentata	.	.	I	.	.	.	.
Cirsium acaule	.	.	I	.	.	.	.
Ophrys bertolonii	.	.	.	.	.	II	.
Avenula praetutiana	.	.	.	.	.	.	IV
Centaurea triumfetti	.	.	.	.	.	.	III
Trinia dalechampii	.	.	.	.	.	.	III
Centaurea ambigua	.	.	.	.	.	.	III
Carex macrolepis	.	.	.	.	.	.	II
Sesleria nitida	.	.	.	.	.	.	I
Polygala major	.	.	.	.	.	.	I
Muscari atlanticum	.	.	.	.	.	.	I
Helianthemum canum	.	.	.	.	.	.	I

Table 6 (continuación)

Synoptic table comparing the association *Trifolio incarnati-Brometum erecti phleetosum ambigui* with some related communities. Values in bold indicate character and differential species of association; other species with only one presence are not reported

No. of relevés	24	9	24	9	18	7	13
Relevé group	A	B	C	D	E	F	G
Species of *Brometalia, Festuco-Brometea*							
Brachypodium rupestre	III	IV	V	V	IV	III	IV
Trifolium campestre	III	III	I	II	IV	II	I
Hippocrepis comosa	I	IV	IV	II	I	I	IV
Sanguisorba minor	V	V	IV	IV	IV	.	II
Leucanthemum vulgare	I	V	III	IV	.	II	II
Rhinanthus alectorolophus	I	III	III	IV	.	I	II
Medicago lupulina	II	III	II	I	.	II	I
Thymus longicaulis	IV	V	.	.	IV	I	V
Teucrium chamaedrys	III	II	III	.	IV	.	I
Trifolium ochroleucum	II	I	.	V	.	II	III
Galium corrudifolium s.l.	IV	.	III	I	IV	II	.
Hieracium pilosella	I	II	I	.	III	.	V
Hieracium piloselloides	I	.	.	.	I	II	.
Trifolium pratense	II	III	V	IV	.	I	.
Briza media	.	III	II	II	.	III	II
Helianthemum nummularium ssp. *obscurum*	.	IV	IV	III	I	.	I
Carex caryophyllea	II	II	III	IV	.	.	.
Anthyllis vulneraria	I	IV	I	.	.	.	IV
Dianthus carthusianorum	II	II	.	.	II	.	I
Galium verum	II	IV	.	V	.	.	.
Crupina vulgaris	I	II	.	.	.	.	I
Eryngium campestre	III	.	.	.	V	I	.
Allium sphaerocephalon	I	.	.	.	I	.	III
Leontodon cichoraceus	II	.	.	.	.	I	IV
Orobanche sp.	.	IV	I	I	.	.	.
Saxifraga bulbifera	II	.	.	.	.	.	II
Knautia purpurea	V	.	.	.	.	.	V
Bupleurum baldense	IV	.	.	.	.	.	I
Thesium linophyllon	.	II	.	.	.	I	.
Salvia pratensis	.	V	.	.	.	.	I
Stachys salviifolia	III	.	.	.	.	.	.
Cerastium arvense ssp. *arvense* var. *etruscum*	III	.	.	.	.	.	.
Marrubium incanum	II	.	.	.	.	.	.
Centaurea scabiosa	.	IV	.	.	.	.	.
Achillea tomentosa	.	III	.	.	.	.	.
Potentilla pusilla	.	II	.	.	.	.	.
Serapias lingua	.	.	II	.	.	.	.
Ophrys fusca	.	.	.	.	.	III	.
Serapias vomeracea	.	.	.	.	.	II	.
Cerastium arvense ssp. *suffruticosum*	.	.	.	.	.	.	V
Asperula cynanchica	.	.	.	.	.	.	V
Potentilla rigoana	.	.	.	.	.	.	V
Primula officinalis	.	.	.	.	.	.	IV
Armeria canescens	.	.	.	.	.	.	IV
Euphrasia stricta	.	.	.	.	.	.	IV
Rhinanthus minor	.	.	.	.	.	.	II
Orchis sambucina	.	.	.	.	.	.	II
Orobanche caryophyllacea	.	.	.	.	.	.	II
Carlina acaulis ssp. *simplex*	.	.	.	.	.	.	II
Campanula glomerata	.	.	.	.	.	.	II
Serratula nudicaulis	.	.	.	.	.	.	I
Orchis ustulata	.	.	.	.	.	.	I
Thymus praecox	.	.	.	.	.	.	I
Dianthus monspessulanum	.	.	.	.	.	.	I
Carlina utzka	.	.	.	.	.	.	I
Alyssum montanum	.	.	.	.	.	.	I
Ononis pusilla	.	.	.	.	.	.	I
Globularia punctata	.	.	.	.	.	.	I
Coronilla minima	.	.	.	.	.	.	I
Dianthus gr. sylvestris	.	.	.	.	.	.	I
Asperula purpurea	.	.	.	.	.	.	I

Table 6 (continuación)

Synoptic table comparing the association *Trifolio incarnati-Brometum erecti phleetosum ambigui* with some related communities. Values in bold indicate character and differential species of association; other species with only one presence are not reported

No. of relevés	24	9	24	9	18	7	13
Relevé group	A	B	C	D	E	F	G
Contacts with *Agropyretalia intermedii-repentis*							
Daucus carota	I	III	V	II	I	V	.
Bromus hordeaceus	III	.	.	.	.	.	.
Rumex acetosa	I	II	.	I	.	.	.
Holcus lanatus	I	.	III	V	.	.	.
Agrostis tenuis	II	.	I	II	.	.	.
Lolium perenne	III	.	I	II	.	.	.
Phleum bertolonii	IV	.	.	.	V	V	.
Picris hieracioides	II	.	.	.	II	V	.
Anthemis tinctoria	II	.	.	.	I	I	.
Convolvulus arvensis	II	.	I	II	.	.	.
Xeranthemum cylindraceum	I	.	.	.	.	II	.
Picris echioides	I	.	.	.	.	II	.
Poa compressa	I	.	.	.	.	I	.
Hedysarum coronarium	.	.	.	.	II	V	.
Ornithogalum gr. umbellatum	I	.	.	.	.	.	.
Sonchus asper	.	.	.	.	.	V	.
Rapistrum rugosum	.	.	.	.	.	III	.
Podospermum laciniatum	.	.	.	.	.	II	.
Cephalaria transsylvanica	.	.	.	.	.	I	.
Other species							
Lotus corniculatus	V	V	V	V	.	II	V
Dactylis glomerata	IV	II	II	II	V	.	.
Achillea millefolium s.l.	II	II	I	II	.	.	III
Festuca arundinacea	II	.	.	II	I	IV	.
Potentilla hirta	II	.	II	II	I	.	.
Arrhenatherum elatius	II	II	I	V	.	.	.
Anthoxanthum odoratum	IV	III	V	V	.	.	.
Luzula campestris	II	III	II	V	.	.	.
Vicia sativa s.l.	II	III	I	.	.	IV	.
Hypericum perforatum	I	.	.	I	IV	.	.
Linum strictum s.l.	II	.	.	.	III	III	.
Sedum rupestre	I	II	.	.	II	.	.
Sedum sexangulare	II	.	.	.	II	.	II
Linum catharticum	I	II	.	.	.	.	V
Sherardia arvensis	III	.	I	II	.	.	.
Leontodon hispidus	.	IV	IV	IV	.	.	.
Knautia arvensis	.	III	I	IV	.	.	.
Lychnis flos-cuculi	.	II	I	V	.	.	.
Poa bulbosa	.	II	I	I	.	.	.
Cruciata glabra	.	.	II	II	.	.	.
Stachys recta	.	II	I	.	.	.	I
Festuca gr. ovina	.	IV	.	.	I	V	.
Linum bienne	.	.	II	II	.	.	I
Rosa canina	I	.	.	.	III	.	.
Prunus spinosa	II	.	.	.	I	.	.
Agrostis stolonifera	I	.	.	.	I	.	.
Hypochoeris achyrophorus	I	.	.	.	.	V	.
Trifolium angustifolium	I	.	.	.	.	I	.
Bunium bulbocastanum	II	.	.	.	.	.	III
Carduus nutans ssp. macrolepis	II	.	.	.	.	.	I
Myosotis arvensis	.	II	I	.	.	.	.
Oenanthe pimpinelloides	.	II	I	.	.	.	.
Bromus racemosus	.	II	.	II	.	.	.
Aristolochia gr. pancinervis	.	.	I	IV	.	.	.
Aira caryophyllea	.	.	II	II	.	.	.
Galium mollugo aggr.	.	.	II	III	.	.	.
Bellis perennis	.	.	II	II	.	.	.
Briza maxima	.	.	II	II	.	.	.
Leopoldia comosa	.	.	II	IV	.	.	.
Vicia bithynica	.	.	I	III	.	.	.
Leontodon autumnalis	.	.	II	I	.	.	.

Table 6 (continuación)
Synoptic table comparing the association *Trifolio incarnati-Brometum erecti phleetosum ambigui* with some related communities. Values in bold indicate character and differential species of association; other species with only one presence are not reported

No. of relevés	24	9	24	9	18	7	3
Relevé group	A	B	C	D	E	F	G
Trifolium dubium	.	.	I	III	.	.	.
Prunella vulgaris	.	.	I	I	.	.	.
Silene italica	.	.	I	I	.	.	.
Viola hirta	.	.	I	II	.	.	.
Ajuga reptans	.	.	I	II	.	.	.
Geranium dissectum	.	.	I	I	.	.	.
Urospermum dalechampii	.	.	II	.	V	.	.
Reichardia picroides	.	.	I	.	I	.	.
Trifolium repens	.	.	I	.	.	.	II
Quercus pubescens	.	.	.	I	II	.	.
Dorycnium hirsutum	.	.	.	.	I	III	.

Other species: *Cynosurus echinatus* IV, *Carlina corymbosa, Petrorhagia prolifera, Crepis neglecta, Poa annua var. vivipara, Orlaya grandiflora* and *Festuca brevipila* III, *Trifolium scabrum, Aegilops geniculata, Trifolium stellatum, Carduus pycnocephalus, Medicago minima, Tragopogon samaritani, Carthamus lanatus, Vicia ochroleuca, Geranium colombinum, Silene paradoxa, Centaurea soltitialis, Xeranthemum inapertum* and *Ranunculus garganicus* II in A; *Rhinanthus gr. serotinus* and *Centaurea gr. nigra* III, *Hypochoeris maculata, Genista tinctoria, Cerastium fontanum, Euphrasia gr. Rostokoviana, Lathyrus pratensis Silene nutans, Potentilla argentea, Aira elegans,Valerianella dentata, Euphorbia cyparissias* and *Armeria pseudoarmeria* II in B; *Peucedanum cervaria* III, *Geranium sanguineum, Hyoseris radiata, Inula conyza, Inula hirta, Bellis sylvestris* and *Avena barbata* II in C; *Poa pratensis* IV, *Silene vulgaris* III and *Poa trivialis* II in D; *Spartium junceum, Santolina etrusca* V and *Helichrysum italicum* V, *Foeniculum vulgare* ssp. *piperitum* and *Equisetum ramosissimum* IV, *Juniperus communis, Pyracantha coccinea, Thesium divaricatum* and *Teucrium polium ssp. capitatum* III, *Crataegus monogyna, Ligustrum vulgare, Linum tenuifolium, Agropyron repens* and *Rubia peregrina* II in E; *Dactylis hispanica* V, *Artemisia cretacea* III, *Inula viscosa, Scorpiurus muricatus, Vicia tenuissima* and *Centaurium pulchellum* II in F; *Senecio gr. doronicum* IV *Myosotis alpestris* III, *Gentiana verna, Minuartia verna* and *Acinos alpinus* II in G.

Relevé source: A. *Trifolio incarnati-Brometum erecti phleetosum ambigui*; B. *Trifolio incarnati-Brometum erecti* (Table 5 in Oberdorfer & Hofman, 1967); C. *Trifolio incarnati-Brometum erecti* (Table 27, group a in Nowak, 1987); D. *Trifolio incarnati-Brometum erecti* (Table 27, group cb in Nowak, 1987); E. *Seselio tortuosi-Brometum erecti* (Table 4 in Angiolini & De Dominicis, 2001); F. *Pseudolysimachio barrelieri-Brometum erecti* (Table 5, rel. 23-29 in Maccherini & al., 1998); G. *Brizo mediae-Brometum erecti* (Table 6 in Biondi & Ballelli, 1982).

Phytogeographic affinities with the western sector of the Mediterranean basin exist but are less evident, the best examples in Tuscany being in the coastal area on siliceous substrates (BALDINI, 1995; SELVI, 1996, 1998). Links with the vegetation of northern Tyrrhenian sectors are indicated by the presence of the association *Trifolio-Brometum*, which in Tuscany could nevertheless be interpreted as an impoverished aspect of Ligurian association, with a new «Antiapenninic» subassociation with a good component of the *Phleo-Bromion*.

From a more conservationist viewpoint, these grasslands, which in the general context of southern Tuscany are of ecological and phytogeographical significance, have become an extremely threatened habitat since they were abandoned in the 1950s. If this situation continues, the natural evolution of this vegetation will bring about its almost total disappearance. Traces will only remain on ledges of rock faces where evolution is prevented by the physical environmental characters. We therefore recommend that these grasslands be placed under active management by experts to conserve them with their existing flora and plant communities.

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APPENDIX

Syntaxa cited in the text but not appearing in the syntaxonomic scheme:

Agropyretea intermedii-repentis (Oberdorfer & *al.* 1967) Müller & Görs 1969
Asperulo purpureae-Brometum erecti Biondi & Ballelli 1981
Brizo mediae-Brometum erecti Biondi & Ballelli 1982
Brometalia rubenti-tectorum Rivas-Martínez & Izco 1997
Cynosurion cristati Tx. 1947
Fagion sylvaticae (Luquet 1926) Tx. & Diemont 1936
Lonicero-Quercion Arrigoni & Foggi 1988
Melico-Quercetum cerridis Arrigoni 1990
Molinio-Arrhenatheretea Tüxen 1937
Onobrychido-Brometum Müller 1966
Pseudolysimachio barrelieri-Brometum erecti Scoppola & Pelosi 1995
Quercetalia pubescenti-petraeae Br.-Bl. (1931) *em.* R. Tx. 1937
Seselio tortuosi-Brometum erecti Angiolini & De Dominicis 2001
Tilio-Acerion Klika 1955
Trachynietalia distachyae Rivas-Martínez 1978.