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Dry grasslands of *Hippocrepido glaucae-Stipion austroitalicae* in the Pollino Massif (Calabria, Italy)

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Abstract – Rocky pastures dominated by *Stipa austroitalica* in the south-east of Italy were classified within an endemic alliance, *Hippocrepido glaucae-Stipion austroitalicae*, originally assigned to a Balkan order (*Scorzoneretalia villosae*). Actually, the distribution area of *S. austroitalica* extends further westwards and large patches are found on the south-east side of the Pollino Massif. This study aims to describe and characterise the plant communities dominated by *S. austroitalica* in this area and analyse their floristic and chorological relationships with other associations of *Hippocrepido-Stipion*. Moreover, their syntaxonomy is discussed in the context of the Italian and south European dry grasslands biogeography. The grasslands were studied on the basis of 19 phytosociological relevés. A larger data set, including 185 relevés with *S. austroitalica*, was used to visualise the relationships among the associations through nonmetric multi-dimensional scaling ordination. The results allowed the description of a new association, *Bupleuro gussonei-Stipetum austroitalicae*, classified within *Hippocrepido-Stipion*. As a consequence, the alliance synrange was extended up to the Pollino Massif. The *Hippocrepido-Stipion*, together with *Cytiso spinescentis-Bromion erecti*, was arranged in *Euphorbietalia myrsinitidis*, an endemic order of the Italian peninsula. The proposed scheme upgrades the syntaxonomy and nomenclature of the dry grasslands vegetation of central and southern Italy.

Keywords: calcareous grasslands, *Euphorbietalia myrsinitidis*, Pollino National Park, *Scorzoneretalia villosae*, *Stipa austroitalica*, syntaxonomy.

Abbreviation: art. – article of the 3rd edition of the International Code of Phytosociological Nomenclature

Introduction

The alliance *Hippocrepido glaucae-Stipion austroitalicae* Forte et Terzi 2005 was originally conceived to describe the Mediterranean steppe-grasslands of two of the largest karst areas in the south-east of Italy, Murge hill and Gargano promontory, and a few other sites in the Molise Region (Fanelli et al. 2001, Forte et al. 2005). The grasslands are characterised by a high floristic richness, with a remarkable phytogeographical value. The dominant species, *Stipa austroitalica* Martinovský, is an endemic species of the south of Italy and is considered a priority species for European biodiversity conservation strategies (Annex II of Directive 92/43/EEC). As a consequence, plant communities of *Hippocrepido-Stipion* are worthy of the highest safeguarding and attention (Paura et al. 2014).

Besides its importance for biodiversity conservation, *Hippocrepido-Stipion* is also of particular concern for the biogeography of Mediterranean vegetation in the European context. In fact, due to the presence of many taxa with a north-eastern Mediterranean and south-eastern European distribution, the alliance was originally classified within a Balkan order, *Scorzonero villosae-Chrysopogonetalia grylli* Horvatić et Horvat in Horvatić 1963 *nom. illeg.* – whose correct name is *Scorzoneretalia villosae* Kovacević 1959 (cf. Terzi in press) – of which it would constitute the south-western outpost (Forte et al. 2005). Actually, the syntaxonomic position of *Hippocrepido-Stipion* raised one more time the question on the relationship between grassland vegetation of the Italian Peninsula and the western Balkans, after it has been debated for nearly 40 years (Lakušić 1969, Horvat et al. 1974, Bonin 1978, Royer 1991, Biondi et al. 1995, Fanelli et al. 2001, Terzi et al. 2010, Biondi and Galdenzi 2012, Terzi and Di Pietro 2013, Di Pietro and Wagensommer 2014, Biondi et al. 2014a).

Although the largest phytocoenoses with *S. austroitalica* can be found along the southern part of the Italian Adriatic border, the species was recorded in many other sites in the south of Italy, with large patches also on the south-east-

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ern side of the Pollino Mountain range, in Calabria Region (Moraldo 1986, Brandmayr et al. 2002). It is interesting to observe that Bonin (1978) – who first extended the distribution area of *Scorzoneretalia villosae* up to southern Italy – based his hypothesis on a phytosociological study on the grasslands of the Pollino Massif. Bonin's relevés (Bonin 1978) were carried out from nearly 800 m above sea level (asl) upward and, even if they include some records of *Stipa mediterranea* Trin. et Rupr., it seems improbable that they could be referred to *S. austroitalica*, whose grasslands develop mainly at lower altitudes, in an area around Castrovillari and nearby towns, in the province of Cosenza (Fig. 1). This area has been widely surveyed for both flora and fauna (i.e., Terraciano 1890, Gavioli 1936, Bernardo and Maiorca 1996, Brandmayr et al. 2002, Bernardo et al. 2011) whereas, despite its importance, it has not been studied from a phytosociological standpoint nor has its vegetation been compared to other *S. austroitalica* associations. It is worth mentioning that these phytocoenoses are also partially included within the Pollino National Park and the proposed Site of Community Importance 'La Petrosa'.

Thus, the aim of this study is threefold: 1) to describe and characterise the plant communities dominated by *S. austroitalica* in the southern side of the Pollino Massif; 2) to analyse their floristic and chorological relationships with other *S. austroitalica* grasslands; 3) to discuss their syntaxonomy in the context of Italian and south European Mediterranean grasslands.

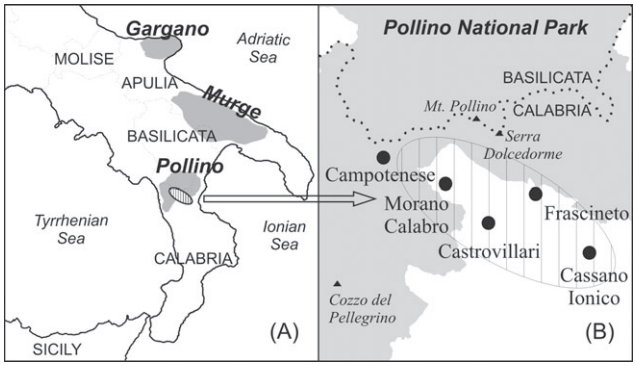

Fig. 1. (A) Map of the south of Italy displaying the mountain range of Murge, Gargano and Pollino. (B) South-eastern part of the National Park of Pollino (shaded area). The study area is indicated by vertical lines.

Material and methods

Study area

The Pollino Massif is located on the border between the Regions of Calabria and Basilicata, in the south of Italy. Its main peaks, Pollino Mountain (2248 m) and Serra Dolcedorme (2267 m), are the highest in southern Italy (Fig. 1). The core area of the massif is made of limestone and dolomitic rocks, cut by faults and deep gorges. In the Calabrian side, around the towns of Castrovillari and Frascineto, the relief degrades south- and eastwards to the Sibari Plain and the Ionian Sea, roughly following the route of the Coscile, the most important river of the area. The geological structure of the area is quite complex with Mesozoic calcareous-dolomite reliefs, quaternary soils of the river basin, sediments of Miocene and Pliocene-Pleistocene deposits, outcrops of Palaeozoic rocks (sericite schists, phyllites, calcareous schists) (Giannini et al. 1963). The *Stipa austroitalica* communities develop mainly on limestone, often outcropping, in an area roughly between 300–800 m asl.

The bioclimate of the study area, deduced from the thermo-pluviometric data of the meteorological station of Castrovillari, is Mediterranean pluvioseasonal-oceanic with a meso-Mediterranean thermotype and a subhumid ombrotype (Fig. 2, Tab. 1). The bioclimatic indexes (Rivas-Martinez 2008, without compensation for the altitude) were calculated on the basis of thermo-pluviometric data available on the institutional web sites of ARPA-Calabria (http://www.cfd.calabria.it/) and Protezione Civile-Apulia (http://www.protezionecivile.puglia.it/).

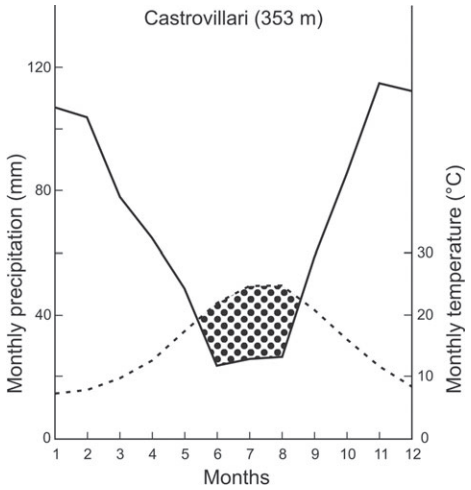

Fig. 2. Ecological climate diagram for Castrovillari, in the province of Cosenza (Italy). The dashed line indicates mean monthly temperature (°C); the solid line indicates mean monthly precipitation (mm).

Vegetation analysis

Rocky pastures dominated by *Stipa austroitalica* in the area surrounding Castrovillari and nearby towns (Fig. 1) were sampled by 16 phytosociological relevés, according to the standard method of the Zürich–Montpellier school (Braun-Blanquet 1932, Westhoff and Van der Maarel 1978). We sampled plant communities with *S. austroitalica* occurring with cover values greater than 30% (i.e., 3, 4 or 5 on the Braun-Blanquet abundance-dominance scale). The plot sizes ranged between 70–100 m^2, which is nearly equal to the mean plot size calculated for the *Hippocrepido-Stipion* (see below). The altitudinal range was between 430 and 700 m asl. Moreover, to take into account the altitudinal variations of grassland vegetation, three additional relevés were carried out near Campotenese at nearly 1000 m asl where *S. austroitalica* is replaced by *Stipa dasyvaginata* Martinovský subsp. *apenninicola* Martinovský et Moraldo (On-line Suppl. Tab. 1, On-line Suppl. Appendix 1).

Tab. 1. Bioclimate of stations representative of some *Stipa austroitalica* associations. Alt. – altituide; Me.po – Mediterranean pluvioseasonal oceanic; Te.oc/sm – temperate oceanic, submediterranean variant; Te (%) – percentage of temperate (hydrologic) years in the time range, Me (%) – percentage of Mediterranean (hydrologic) years; mme – mesomediterranean; tme – thermomediterranean; mte – mesotemperate; sme – supramediterranean; sec – dry; shu – subhumid; hum – humid; i – lower belt; s – upper belt; Cont. – continentality type; euoc – euoceanic; smct – semicontinental; Ic – index of continentality; Io – ombrothermic index; Tp – yearly positive temperature; Itc – compensated thermicity index. (1): from Fascetti et al. (2013).

Stations	Alt. (m)	Time range	Bioclimate	Te (%)	Me (%)	Thermo-type	Ombro-type	Cont.	Ic	Io	Tp	Itc
Manfredonia	2	1950–2010	Me.po	11.7	88.3	mme.i	sec.i	euoc	16.5	2.4	1869.4	314.4
Reggio Calabria	15	1950–2010	Me.po	0.0	100.0	tme.i	sec.i	euoc	14.8	2.7	2218.7	422.2
Crispiano	265	1950–2010	Me.po	25.0	75.0	mme.i	sec.s	smct	17.3	3.0	1923.2	320.5
Castrovillari	353	1950–2010	Me.po	26.7	73.3	mme.i	shu.i	smct	17.5	4.6	1831.8	297.8
Matera	401	1950–1999	Me.po	36.7	63.3	mme.i	sec.s	smct	18.2	3.1	1814.1	286.5
Altamura	461	1950–2010	Me.po	31.7	68.3	mme.s	sec.s	smct	18.4	3.2	1759.4	271.1
S. Giovanni Rotondo	557	1950–2010	Te.oc/sm	68.3	31.7	mte.i	shu.s	smct	17.9	5.0	1654.9	249.0
Moliterno (1)	879	1926–1987	Me.po			sme	hum.i	smct	18.4			

Ordination

To visualise the floristic, chorological and life-form relationships among the studied pastures and those already assigned to the *Hippocrepido glaucae-Stipion austroitalicae* or to other grasslands with *S. austroitalica*, a larger data set (185 relevés) was carried out by adding relevés already published and assigned to the "community with *Ephedra nebrodensis* and *Scorzonera villosa* subsp. *columnae* (Gargano)" and the following associations: *Chamaecytiso spinescentis-Stipetum austroitalicae* Terzi et Forte 2005 (Murge of Matera), *Irido pseudopumilae-Scorzoneretum columnae* Di Pietro, Misano et Terzi 2010 (south-eastern Murge), *Convolvulo elegantissimi-Stipetum austroitalicae* Biondi et Guerra 2008 (south-eastern Murge), *Centaureo apulae-Andropogonetum distachyi* Biondi et Guerra 2008 (art. 44, south-eastern Murge), *Stipo austroitalicae-Hyparrhenietum hirtae* Biondi et Guerra 2008 (south-eastern Murge), *Cardopato corymbosi-Brometum erecti* Biondi et Guerra 2008 (south-eastern Murge), *Chamaeleono gummiferi-Stipetum austroitalicae* Brullo, Scelsi et Spampinato 2001 (Aspromonte), *Sideritido italicae-Stipetum austroitalicae* Fanelli, Lucchese & Paura corr. Terzi, Di Pietro et D'Amico 2010 (Gargano), *Stipo austroitalicae-Seslerietum juncifoliae* Di Pietro et Wagensommer 2014 (Gargano), *Phagnalo illyrici-Stipetum frentanae* Terzi, Di Pietro et D'Amico 2010 (Molise), *Polygalo mediterraneae-Stipetum austroitalicae* Terzi, Di Pietro et D'Amico 2010 (Dauno sub-Apennine), *Acino suaveolentis-Stipetum austroitalicae* Forte & Terzi, 2005 (north-western Murge), *Anthemido columnae-Stipetum austroitalicae* Fascetti, Pirone et Rosati 2013 (Maddalena Mts.) (Brullo et al. 2001, Fanelli et al. 2001, Forte et al. 2005, Biondi and Guerra 2008, Di Pietro and Wagensommer 2008, Terzi et al. 2010, Fascetti et al. 2013, Di Pietro and Wagensommer 2014, On-line Suppl. Appendix 2). Species abundance-dominance values were transformed to the ordinal scale proposed by Van der Maarel (1979). The plot sizes of relevés vary from 2 to 350 m^2, with an average value of nearly 80 m^2. Only relevés with a plot size of 10–200 m^2 were retained together with the nomenclatural type relevés; the types were kept even if their plot sizes exceeded the given thresholds. The resulting data set (consisting of 164 relevés) was ordinated by nonmetric multi-dimensional scaling (NMDS, Kruskal 1964, Mather 1976) after outlier relevés had been removed. Outlier analysis was performed by pc-ord software 6.11 (McCune and Mefford 2011), considering as outliers those relevés that were more than 2.00 standard deviation units away from the mean. NMDS was carried out by using the 'thorough and slow' option of the pc-ord autopilot mode, with the Relative Sørensen distance (McCune and Grace 2002).

Chorotypes and life-forms refer to Pignatti (1982). The following chorotypes were used: Circum-Adriatic; Atlantic, including also European-Atlantic and sub-Atlantic taxa; Circumboreal; Endemic, including also subendemic species; Eurosiberian; Eurasiatic; European; Mediterranean-Atlantic; eury-Mediterranean; steno-Mediterranean; Mediterranean-Montane, including also the south and south-east European orophytes; Paleotemperate; Wide Distribution taxa, including the remaining types (e.g., Cosmopolitan, sub-Cosmopolitan). Within the previous chorological types, Pignatti (1982) recognizes some "eastern" taxa (i.e., east steno-Mediterranean, east eury-Mediterranean, east Mediterranean-Montane, south-east European and circum-Adriatic taxa). To evaluate their influence on the associations, the percentages of these "eastern" taxa were separately calculated and summarised in another additional type (referred as "Est" in Table 3). The strengths of the relationships between life-forms and chorotypes and NMDS ordination scores were visualised throughout joint plots with an r^2 cut-off arbitrarily set at 0.30. As summarising data, life-form and chorological spectra were also calculated on the basis of species frequency in the original diagnoses of the associations (Tab. 3).

Nomenclature

Taxonomic nomenclature refers to Euro+Med Plantbase and subordinately to Conti et al. (2005) and recent taxonomic monographs (Gonzalo et al. 2013, Quintanar and Castroviejo 2013, Gallo 2014). Regarding *S. austroitalica*, three subspecies were identified in the study area (Moraldo

1986) but, as claimed by Bernardo et al. (2011), and we agree with them, their distinction is difficult on the basis of the indicated diagnostic traits. A recent dissertation on the issue (Gonzalo et al. 2013) recognises only two subspecies of *S. austroitalica*, one (*S. a.* subsp. *sicula*) being endemic of Sicily. Following this last revision, all the records from the study area were referred to *S. austroitalica* subsp. *austroitalica*. For *S. dasyvaginata*, we referred to the revision of Moraldo (1986) who observed that when moving away from the *locus classicus* (Simbruini Mountains), it becomes difficult to find the typical traits of the taxon. The taxonomic relationship between *S. dasyvaginata* and *Stipa eriocaulis* Borbás subsp. *eriocaulis* is in fact uncertain and molecular analyses are needed to clarify it (Gonzalo et al. 2013). For *Koeleria*, taxonomic nomenclature refers to the recent revision paper by Quintanar and Castroviejo (2013).

For the phytosociological nomenclature, the rules of the 3rd edition of the International Code of Phytosociological Nomenclature (ICPN, Weber et al. 2000) were followed. Correct names of syntaxa were quoted throughout the text even if they replace other names commonly used in scientific literature. These latter were listed as synonyms in the syntaxonomic scheme below.

Results

Vegetation

Grasslands dominated by *Stipa austroitalica* in the south-east of the Pollino Massif include some taxa that have been already considered diagnostic for *Hippocrepido glaucae-Stipion austroitalicae* (e.g., *S. austroitalica*, *Thymus spinulosus* Ten., *Scorzonera villosa* Scop. subsp. *columnae* (Guss.) Nyman, *Hippocrepis glauca* Ten., *Melica transsilvanica* Schur subsp. *transsilvanica*) or have been recorded with high frequencies in its communities, such as *Bromopsis erecta* (Huds.) Fourr., *Koeleria splendens* C. Presl, *Teucrium capitatum* L. subsp. *capitatum*, *Anthyllis vulneraria* L., *Avena barbata* Link, *Eryngium campestre* L., *Galium corrudifolium* Vill., *Briza maxima* L., *Dasypyrum villosum* (L.) P. Candargy (cf. Terzi et al. 2010).

The physiognomy of the phytocoenoses is mainly due to the high abundance-dominance value of *S. austroitalica* and other caespitose hemicryptophytes (*B. erecta*, *Brachypodium retusum* (Pers.) P. Beauv., *Dactylis glomerata* L. subsp. *hispanica* (Roth) Nyman) as well as chamaephytes, such as *T. spinulosus*, *Euphorbia spinosa* L. or *T. capitatum* subsp. *capitatum*.

Notwithstanding the general floristic and structural similarities with other *S. austroitalica* communities, those from the Pollino area are floristically quite differentiated by some species, among which are the steno-endemic *Bupleurum gussonei* (Arcang.) Snogerup & B. Snogerup (cf. Snogerup and Snogerup 2001) and the south European *Euphorbia rigida* M. Bieb. These two species are considered as diagnostic of the new association *Bupleuro gussonei-Stipetum austroitalicae ass. nov.* (Tab. 2, On-line Suppl. Tab. 1, rel. 1–16). *E. rigida* has been already considered as diagnostic for *Euphorbion rigidae* Brullo et Spampinato 1990 which develops in different ecological conditions, being typical of chamaephytic vegetation on incoherent substrata in hilly

Tab. 2. The *Bupleuro gussonei-Stipetum austroitalicae ass. nov. hoc loco*: *holotypus*.

Date and geographic coordinates: 19/05/2010, 39° 49' 01'', 16° 17' 13''
Altitude: 445 m a.s.l.
Exposition: 290°
Slope: 30 %
Cover: 100 %
Plot size: 100 m^2

Species: *Stipa austroitalica* Martinovský subsp. *austroitalica* (5), *Bromopsis erecta* (Huds.) Fourr. (3), *Brachypodium retusum* (Pers.) P. Beauv. (2), *Scorzonera villosa* Scop. subsp. *columnae* (Guss.) Nyman (2), *Thymus spinulosus* Ten. (2), *Dactylis glomerata* L. subsp. *hispanica* (Roth) Nyman (1), *Festuca circummediterranea* Patzke (1), *Hypochaeris achyrophorus* L. (1), *Nigella damascena* L. (1), *Rostraria cristata* (L.) Tzvelev (1), *Seseli tortuosum* L. (1), *Aira caryophyllea* L. (+), *Anagallis arvensis* L. (+), *Anisantha madritensis* (L.) Nevski (+), *Anthyllis vulneraria* L. (+), *Asterolinon linum-stellatum* (L.) Duby (+), *Avena barbata* Link (+), *Bellardia trixago* (L.) All. (+), *Briza maxima* L. (+), *Bromus intermedius* Guss. (+), *Bupleurum baldense* Turra (+), *Bupleurum gussonei* (Arcang.) Snogerup & B. Snogerup (+), *Campanula erinus* L. (+), *Carduus nutans* L. subsp. *perspinosus* (Fiori) Arènes (+), *Carlina corymbosa* L. (+), *Centaurea deusta* Ten. (+), *Centaurium erythraea* Rafn (+), *Cephalaria leucantha* (L.) Roem. & Schult. (+), *Clinopodium nepeta* (L.) Kuntze subsp. *glandulosum* (Req.) Govaerts (+), *Convolvulus cantabrica* L. (+), *Convolvulus elegantissimus* Miller (+), *Coronilla scorpioides* (L.) W. D. J. Koch (+), *Crepis rubra* L. (+), *Crupina crupinastrum* (Moris) Vis. (+), *Cytisus spinescens* C. Presl (+), *Dasypyrum villosum* (L.) P. Candargy (+), *Echium vulgare* L. (+), *Elaeoselinum asclepium* (L.) Bertol. (+), *Eryngium amethystinum* L. (+), *Eryngium campestre* L. (+), *Erysimum pseudorhaeticum* Polatschek (+), *Euphorbia exigua* L. (+), *Euphorbia rigida* M. Bieb. (+), *Galium corrudifolium* Vill. (+), *Gastridium ventricosum* (Gouan) Schinz & Thell. (+), *Koeleria splendens* C. Presl (+), *Linum strictum* s.l. (+), *Linum tryginum* L. (+), *Malva cretica* Cav. (+), *Matthiola fruticulosa* (L.) Maire (+), *Micromeria graeca* (L.) Benth. (+), *Micromeria graeca* (L.) Benth. subsp. *fruticulosa* (Bertol.) Guinea (+), *Odontites luteus* (L.) Clairv. (+), *Ophrys tenthredinifera* Willd. (+), *Orchis coriophora* L. (+), *Ornithogalum montanum* Cirillo (+), *Phleum hirsutum* Honck. subsp. *ambiguum* (Ten.) Tzvelev (+), *Poa bulbosa* L. (+), *Polygala monspeliaca* L. (+), *Potentilla pedata* Wild (+), *Reichardia picroides* (L.) Roth (+), *Salvia verbenaca* L. (+), *Sanguisorba minor* Scop. (+), *Scandix pecten-veneris* L. (+), *Serapias vomeracea* (Burm. f.) Briq. (+), *Sherardia arvensis* L. (+), *Sixalix atropurpurea* (L.) Greuter & Burdet (+), *Stachys germanica* L. subsp. *salvifolia* (Ten.) Gams (+), *Stipa capensis* Thunb. (+), *Teucrium capitatum* L. subsp. *capitatum* (+), *Teucrium chamaedrys* L. (+), *Tragopogon porrifolius* L. (+), *Trifolium campestre* Schreber (+), *Trifolium scabrum* L. subsp. *scabrum* (+), *Trifolium stellatum* L. (+), *Trigonella gladiata* M. Bieb. (+), *Tyrimnus leucographus* (L.) Cass. (+), *Urospermum dalechampii* (L.) F. W. Schmidt (+), *Valeriana tuberosa* L. (+), *Valeriana tuberosa* L. (+), *Valerianella muricata* (Stev. ex M. Bieb.) J.W. Loudon (+), *Vincetoxicum hirundinaria* Medik. (+), *Vulpia ciliata* Dumort. (+), *Xeranthemum inapertum* (L.) Mill. (+).

and mountainous river valleys of Sicily and southern Italy (Brullo and Spampinato 1990). The *Euphorbion rigidae* has been classified within the *Thlaspietea rotundifolii* Br.-Bl. 1948 (*Scrophulario bicoloris-Helichrysetalia italici* Brullo 1984) whose character species are rather rare or absent in *Bupleuro-Stipetum*, where *E. rigida* acts as a differential species.

The new association describes the rocky pastures dominated by *S. austroitalica*, developing on calcareous substrata of the Pollino Massif, between nearly 300 and 800 m above sea level, under a semi-continental Mediterranean pluvioseasonal-oceanic bioclimate, in the meso-Mediterranean thermotype (Fig. 2, Tab. 1).

These pastures are often juxtaposed with other xerothermic grasslands dominated by *Hyparrhenia hirta* (L.) Stapf, with which they share many species. As a consequence, many frequent taxa of *Bupleuro-Stipetum*, and among them many annuals, are ingressives from *Thero-Brachypodietea* s.l. Their presence has been observed in nearly all the associations of *Hippocrepido-Stipion* and some of them can be considered as differential species of the alliance.

Towards higher altitudes, the sociological importance of *S. austroitalica* decreases until it is substituted for by *Stipa dasyvaginata subsp. apenninicola* in quite different communities (On-line Suppl. Tab. 1, rel. 17–19) with *Seseli tommasinii* Rchb. f., *Helictochloa versicolor* (Vill.) Romero Zarco subsp. *praetutiana* (Arcang.) Romero Zarco, *Sideritis italica* (Mill.) Greuter & Burdet, *Crepis lacera* Ten., *Cerastium tomentosum* L., *Euphorbia myrsinites* L., *Brachypodium rupestre* (Host) Roem. & Schult. and others. These communities are clearly related to *Cytiso spinescentis-Bromion erecti* Bonin ex Bonin 1978. It is interesting to notice that some taxa that frequently inhabit the *S. austroitalica* grasslands on the Adriatic side of the Italian Peninsula (e.g., *Euphorbia myrsinites* in the *Acino-Stipetum* of Murge, *Sideritis italica* in the *Sideritido-Stipetum* of Gargano) are rare or absent in *Bupleuro-Stipetum* while on the contrary they can be found in the upper vegetation belt.

NMDS ordination

The three-axis solution of the NMDS ordination attained a minimum stress of 14.83. The three axes explained nearly 80% of total variation, being 40.4%, 25.0% and 13.6% the proportion of variance represented by each axis respectively. Only the first two axes are shown (Fig. 3) and discussed below. Axis 1 roughly represents an altitudinal gradient from the more xerothermic associations of lower altitude (*Chamaeleono-Stipetum*, *Convolvulo-Stipetum*, *Centaureo-Andropogonetum*, *Stipo-Hyparrhenietum* and *Irido-Scorzoneretum*), with a high percentage of steno-Mediterranean species, to associations of higher altitudes on the left, with a greater percentage of chamaephytes, Mediterranean Montane and European taxa (*Anthemido-Stipetum*, *Sideritido-Stipetum*, *Stipo-Seslerietum* and the relevés 17–19 of Tab. 2). Increasing altitude is also associated with a higher percentage of 'eastern' species (Fig. 3). The associations originally assigned to *Hyparrhenietalia hirtae* Rivas-Martinez 1978 (Brullo et al. 2001, Biondi and Guerra 2008, see also Terzi et al. 2010) are situated in the upper right hand side of the diagram. Among them, *Chamaeleono-Stipetum* is well differentiated for the low number of species, the very low percentage of therophytes and the highest amount of steno-Mediterranean taxa.

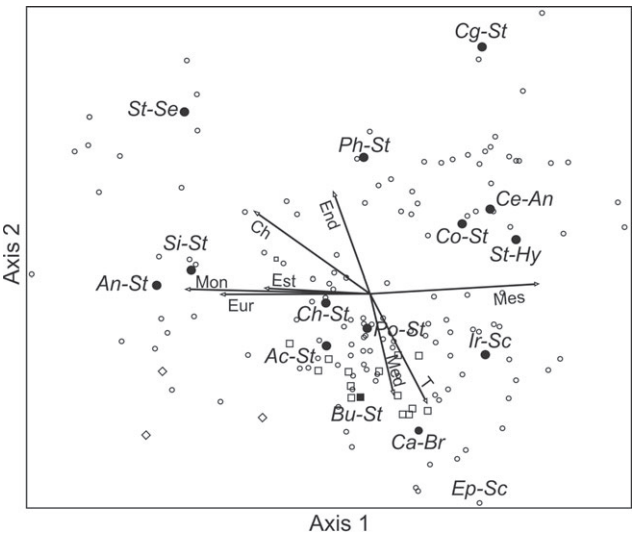

Fig. 3. Nonmetric multi-dimensional scaling ordination. The square symbols represent relevés of the *Bupleuro-Stipetum austroitalicae,* the circular ones those of the other associations. The relevés 17–19 of Tab. 2 are indicated by rhombus symbols. Filled squares/circles indicate the nomenclatural types of the associations, whose abbreviations are written next to them (cf., Tab. 3). For the "Community with *Ephedra nebrodensis* and *Scorzonera villosa* subsp. *columnae*", the abbreviation is placed next to the first relevé of the original table (Di Pietro and Wagensommer 2008). Mes – steno-Mediterranean ($r^2 = 0.54$), T – Therophytes ($r^2 = 0.35$), Med – eury-Mediterranean ($r^2 = 0.33$), Mon – Montane ($r^2 = 0.59$), Eur – European ($r^2 = 0.48$), Est – Eastern taxa ($r^2 = 0.34$), Ch – Chamaephytes ($r^2 = 0.37$), End – Endemics ($r^2 = 0.33$).

In the central-lower part of the diagram, there are associations characterised by higher percentages of therophytes (except for *Cardopato-Brometum*, Tab. 3) and eury-Mediterranean species (*Polygalo-Stipetum*, *Chamaecytiso-Stipetum*, *Acino-Stipetum*, *Cardopato-Bromion*, *Bupleuro-Stipetum*, *Irido-Scorzoneretum* and the *Ephedra nebrodensis* and *Scorzonera villosa* subsp. *columnae* community).

The *Bupleuro-Stipetum* showed high percentage of both steno- and eury-Mediterranean taxa, on the whole at nearly 70% (Tab. 3). The association is among those with the highest percentage of therophytes that roughly equals hemicryptophytes, followed by chamaephytes. Similar life-form spectra characterise also the other associations of the *Hippocrepido-Stipion*, such as the *Acino-Stipetum* of the Murge hill (Tab. 3). In few associations, such as *Stipo-Seslerietum* or *Anthemido-Stipetum*, hemicryptophytes are numerically dominant whereas chamaephytes increase and therophytes decrease. These associations share many species with the *Cytiso-Bromion* and mark the transition from the *Hippocrepido-Stipion* to the upper vegetation belt. The same general pattern was also observed for the life-form spectra weighted with species cover values (data not shown).

Tab. 3. Life forms and chorological spectra, weighted by species frequency, of the associations included in the data set. Life forms: Ch – Chamaephytes; G – Geophytes; H – Hemicryptophytes; P – Phanerophytes; T – Therophytes. Chorotypes: Adr – Circum-Adriatic; Atl – Atlantic; Cbr – Circumboreal; End – Endemic; Esi – Eurosiberian; Eua – Eurasiatic; Eur – European; Mea – Mediterranean-Atlantic; Med – eury-Mediterranean; Mes – steno-Mediterranean; Mon – Mediterranean-Montane; Pal – Paleotemperate; Wid – other types; Est – percentage of "eastern" taxa, already included in the previous types.

Associations	Code	Life forms (%)					Chorotypes (%)													Est (%)
		Ch	G	H	P	T	Adr	Atl	Cbr	End	Esi	Eua	Eur	Mea	Med	Mes	Mon	Pal	Wid	
Acino suaveolentis-Stipetum austroitalicae	Ac-St	10.5	8.7	37.7	1.0	42.1	0.0	0.1	0.0	11.6	2.0	1.4	5.5	0.2	36.1	31.1	4.4	5.8	1.8	7.5
Anthemido columnae-Stipetum austroitalicae	An-St	22.5	15.0	50.8	1.3	10.4	0.8	1.7	0.4	12.9	2.1	7.9	12.9	0.4	25.4	10.0	13.3	10.8	1.3	11.7
Bupleuro gussonei-Stipetum austroitalicae	Bu-St	10.9	7.4	38.4	3.3	40.0	0.9	0.0	0.0	8.6	2.4	0.9	5.5	1.1	36.0	33.5	2.7	5.2	3.0	8.4
Cardopato corymbosi-Brometum erecti	Ca-Br	7.3	12.1	59.3	3.6	17.7	0.0	0.8	0.0	5.2	3.6	7.3	9.3	2.4	40.7	14.1	3.2	12.5	0.8	9.7
Centaureo-Andropogonetum distachyi	Ce-An	4.6	16.1	54.0	0.0	25.3	0.0	0.0	0.0	19.5	4.6	1.1	2.3	0.0	24.1	31.0	4.6	11.5	1.1	6.9
Chamaecytiso spinescentis-Stipetum austroitalicae	Ch-St	10.9	6.3	48.0	1.6	33.2	3.3	2.0	0.0	10.9	0.0	0.3	10.2	0.7	29.9	27.0	4.3	10.5	1.0	11.2
Chamaeleono gummiferi-Stipetum austroitalicae	Cg-St	16.0	17.2	59.5	1.2	6.1	0.0	0.0	0.0	9.8	0.6	0.0	5.5	0.0	15.3	58.3	0.0	4.9	5.5	0.6
Convolvulo elegantissimi-Stipetum austroitalicae	Co-St	8.9	15.7	45.1	1.3	28.9	0.9	0.0	0.0	14.0	0.9	0.9	4.3	1.3	27.7	35.7	0.9	9.8	3.8	7.2
Irido pseudopumilae-Scorzoneretum columnae	Ir-Sc	6.1	13.1	27.5	4.4	48.9	0.5	0.0	0.0	7.6	0.6	0.8	3.1	1.5	37.7	37.7	0.3	6.4	3.7	4.7
Phagnalo illyrici-Stipetum frentanae	Ph-St	21.8	8.6	44.3	5.2	20.1	2.3	0.0	0.0	10.3	4.0	0.0	4.6	0.0	38.5	29.3	3.4	5.2	2.3	6.9
Polygalo mediterraneae-Stipetum austroitalicae	Po-St	8.2	6.6	47.5	1.4	36.3	0.8	0.0	0.6	7.8	3.6	2.1	8.0	0.7	37.8	27.0	2.2	7.5	1.9	7.5
Sideritido italicae-Stipetum austroitalicae	Si-St	16.8	12.4	46.4	0.5	23.9	0.4	0.0	0.0	10.6	2.1	4.6	12.0	0.9	29.2	25.0	7.6	5.7	1.9	8.0
Stipo austroitalicae-Hyparrhenietum hirtae	St-Hy	11.3	14.7	44.1	2.3	27.7	0.0	0.0	0.0	10.2	1.7	0.6	2.3	0.6	24.3	46.3	1.1	7.3	5.6	4.0
Stipo austroitalicae-Seslerietum juncifoliae	St-Se	29.2	4.6	55.1	3.2	7.8	7.0	1.0	0.0	19.9	1.0	3.2	14.1	0.4	21.9	12.5	13.3	3.8	1.8	17.1
Community with *Ephedra nebrodensis* and *Scorzonera villosa* subsp. *columnae*	Ep-Sc	6.6	10.7	21.1	3.7	57.9	0.0	0.0	0.0	9.1	2.5	2.9	3.3	0.0	39.7	32.6	1.7	3.3	5.0	3.7

From a bioclimatic standpoint, the bioclimate of Castrovillari turned out to be intermediate among those of Crispiano (province of Taranto), Matera and Altamura (province of Bari), except for the higher mean annual precipitations (Tab. 1). In fact, in the ordination diagram, the *Bupleuro-Stipetum* is placed near *Chamaecytiso-Stipetum* (Matera), *Acino-Stipetum* (NW-Murge, Altamura) and *Cardopato-Bromion* (Crispiano).

The bioclimate of Reggio Calabria – in the south-western part of the Italian Peninsula, where *Chamaeleono-Stipetum* develops – stands out as the most Mediterranean, with a thermo-Mediterranean thermotype and a dry ombrotype. In the south of Gargano, at the same altitude, Manfredonia, in the province of Foggia, shows a higher continental tendency and a meso-Mediterranean thermotype and a subhumid ombrotype, highlighting the bioclimatic differences between the eastern and western sides of the Italian Peninsula. Near Manfredonia and San Giovanni Rotondo, in the Gargano Promontory – where the bioclimate is sub-Mediterranean temperate – *Sideritido-Stipetum* and *Stipo-Seslerietum* were described. These two associations are placed in the ordination diagram near *Anthemido-Stipetum,* which develops near Moliterno, in the province of Potenza, under a Mediterranean climate within the supra-Mediterranean thermotype and humid ombrotype.

In a nutshell, the represented associations develop along a bioclimatic gradient that goes from the bioclimates of Reggio Calabria and Manfredonia to those of Moliterno and S. Giovanni Rotondo.

Discussion

The presence within *Bupleuro-Stipetum* of numerous characters and frequent taxa of *Hippocrepido glaucae-Stipion austroitalicae* proves the ecological relationship between the new association and the other ones already assigned to the alliance. The relationship is also highlighted by the life-form and chorological standpoints (Fig. 3, Tab. 3).

The alliance *Hippocrepido-Stipion* occupies a vegetation belt intermediate between the thermo-Mediterranean vegetation of the class *Thero-Brachypodietea* s.l. and the typical Apennine vegetation of the *Cytiso-Bromion* (*Festuco-Brometea* Br.-Bl. et Tx. ex Klika et Hadač 1944). This vegetation belt is well represented in the south-east of Italy (Murge and Gargano) while it is thinner and restricted to local patches west- and southwards. *Bupleuro-Stipetum* develops in the lower part of the gradient so that, together with species of *Festuco-Brometea*, such as *Bromopsis erecta*, *Eryngium amethystinum* and *Koeleria splendens*, it also includes many species from *Thero-Brachypodietea* s.l. The classification within *Hippocrepido-Stipion* is due to the sociological role of species such as *S. austroitalica*, *S. villosa* subsp. *columnae*, *T. spinulosus*, *H. glauca*, that, especially in the south-east of Italy, show their preference for *Festuco-Brometea*. In fact, within other classes they lose their importance and are generally recorded with lower cover values.

Similar situations, intermediate between *Thero-Brachypodietea* s.l. and *Festuco-Brometea*, have been observed

along the entire Mediterranean edge of Europe (Royer 1991, Apostolova et al. 2014, Pirini et al. 2014). In the western Mediterranean, Barbero and Loisel (1972) included these vegetation types within the *Brachypodio-Brometalia* Barbero et Loisel 1972 which in their opinion should replace the Balkan *Scorzoneretalia villosae* and its southeastern vicariant, *Astragalo onobrychidis-Potentilletalia* Micevski 1971. The *Brachypodio-Brometalia* originally included two suborders: *Astragalo-Festucenalia* Barbero et Loisel 1972 and *Brachypodienalia phoenicoidis* (Braun-Blanquet ex Moliner 1934) Barbero et Loisel 1972. The latter is more often considered with its original rank of order.

The syntaxonomic positions of *Scorzoneretalia villosae*, *Brachypodietalia phoenicoidis* and *Astragalo-Potentilletalia*, have not been unanimously interpreted as they were classified both within the *Thero-Brachypodietea* s.l. or *Festuco-Brometea*. The 'uncertain' syntaxonomic position can be easily detected comparing many large scale revisions or synopses where the orders are placed in different classes (e.g., Blečić and Lakušić 1976, Lakušić et al. 1978, Royer 1991, Redžić 1999, Rodwel et al. 2002, Bardat et al. 2004, Trinajstić 2008, Biondi et al. 2014b). Moreover, the *Scorzoneretalia villosae* was also divided into two orders that were arranged within *Thero-Brachypodietea* s.l. and *Festuco-Brometea* respectively (Horvatić 1973).

For the Adriatic side of the Balkan Peninsula, a third and intermediate class, called *Brachypodio-Chrysopogonetea* Horvatić 1963, was proposed (Horvatić 1958, 1963). The same idea was then extended to the southern European margin under the illegitimate name *Brachypodio-Brometea* Barbero et Loisel 1972 *nom. illeg.* (art. 29c, Barbero and Loisel 1972, Terzi in press). However, this proposal has not been the subject of any wide consensus in more recent scientific literature. Some recent papers on the issue considered the orders quoted above within *Festuco-Brometea* (Rodwell et al. 2002, Pirini et al. 2014, Apostolova et al. 2014, Terzi in press).

In the south of Italy, *Hippocrepido-Stipion* was originally classified within *Scorzoneretalia villosae* and *Festuco-Brometea* (cf. Fanelli et al. 2001, Forte et al. 2005). Therefore, it was separated at the order level from the Apennine dry grasslands of the *Cytiso-Bromion* and instead arranged within the *Brometalia erecti* Koch 1926 (Royer 1991, Biondi et al. 1995). Ubaldi (1997) proposed to differentiate the xeric grasslands of the *Brometalia erecti* within a new order that was validated some years later under the name *Artemisio albae-Brometalia erecti* Ubaldi ex Mucina et Denggler (Mucina et al. 2009). Other authors (Biondi and Galdenzi 2012), following the syntaxonomic arrangement of Bonin (1978), reunited both *Hippocrepido-Stipion* and *Cytiso-Bromion* (sub *Phleo ambigui-Bromion erecti* Biondi et al. ex Biondi et Galdenzi 2011 *nom. illeg.*) under the same order, *Scorzoneretalia villosae*. By contrast, Ubaldi (2011) assigned *Hippocrepido-Stipion* to *Thero-Brachypodietea* s.l. and the Apennine grasslands to several new other orders and alliances, almost all invalidly described, of *Festuco-Brometea*. Summarising, the two Italian alliances, *Hippocrepido-Stipion* and *Cytiso-Bromion*, have been classified in two different classes (Ubaldi 2011), in different orders of *Festuco-Brometea* (Forte et al. 2005) or within the same Balkan order (Biondi and Galdenzi 2012).

From the above, it is clear that a definitive syntaxonomic scheme should be obtained by a large scale study (yet lacking), at least on a European scale, which will clarify through modern statistical methods the floristic relationships among all the high rank syntaxa involved and evaluate the different interpretations given up to now.

For the circum-Adriatic area, the preliminary results of a revision comparing *Artemisio-Brometalia* and *Scorzoneretalia villosae* highlighted important differences in the frequencies of some species along the opposite side of the Adriatic Sea (Terzi and Di Pietro 2013). Moreover, taxa such as *Chrysopogon gryllus* (L.) Trin., *Festuca illyrica* Markgr.-Dann., *Festuca valesiaca* Schleich. ex Gaudin, *Stipa eriocaulis* Borbás, *Satureja subspicata* Bartl., *Scorzonera villosa subsp. villosa* are frequent or dominant in the sub-Mediterranean Balkan grasslands while others prevail on the Italian side (e.g., *Festuca circummediterranea* Patzke, *Phleum hirsutum* Honck. subsp. *ambiguum* (Ten.) Tzvelev, *S. austroitalica*, *Thymus spinulosus*, *Crepis lacera* Ten., *Sideritis italica* (Mill.) Greuter & Burdet, *Scorzonera villosa* subsp. *columnae*) (see also Di Pietro and Wagensommer 2014). Despite some circum-Adriatic taxonomic similarities, that have been observed for a very long time, the presence of many endemic taxa suggested a syntaxonomic scheme with three orders: with an endemic Italian peninsular order differentiated from the *Artemisio-Brometalia* (Central Europe and NW Italy) and *Scorzoneretalia villosae* (Western Balkan and NE Italy) (Terzi and Di Pietro 2013). The Italian order would include at least the two alliances *Cytiso-Bromion* and *Hippocrepido-Stipion*. Similar observations led Biondi et al. (2014a) to define a new endemic order for the Italian Peninsula. However, to the best of our knowledge, the earlier available valid name for such an order is *Euphorbietalia myrsinitidis* Ubaldi 2011, whereas other names are to be listed as synonyms.

The considerations given above led to an upgrade of the syntaxonomy and nomenclature currently used in the Italian literature (cf. Biondi et al. 2014). The following scheme is here proposed:

Class: Festuco-Brometea Br.-Bl. et Tx. ex Klika et Hadač 1944

Ord.: Euphorbietalia myrsinitidis Ubaldi 2011 [*holotypus*: *Sideritidion italicae* (Biondi, Ballelli, Allegrezza et Zuccarello 1995) Ubaldi 2011; synonyms: *Brometalia caprini* Ubaldi 1997 *nom. inval*. (art. 2b, 3o), *Festuco-Seslerietalia nitidae* 2003 *nom. inval*. (art. 2b, 8), *Asphodelino liburnicae-Brometalia erecti* Ubaldi 2011 *nom. inval*. (art. 2b), *Phleo ambigui-Brometalia erecti* Biondi, Allegrezza, Blasi et Galdenzi in Biondi, Allegrezza, Casavecchia, Galdenzi, Gasparri, Pesaresi, Vagge et Blasi 2014).

All.: Cytiso spinescentis-Bromion erecti Bonin ex Bonin 1978 (*lectotypus*: *Lavandulo angustifoliae-Asphodelinetum luteae* Bonin 1978; Synonyms: *Cytiso-Bromion caprini* Bonin in Barbero et Bonin 1969 *nom. inval.* (art. 2b, 3b), *Cytiso-Bromion caprini* Bonin 1969 *nom. inval*. (art. 2b), *Crepido lacerae-Phleion ambigui* Biondi et Blasi 1982 *nom. inval.* (art. 3o), *Phleo ambigui-Bromion erecti* Biondi et

Blasi ex Biondi, Ballelli, Allegrezza et Zuccarello 1995 *nom. inval.* (art. 30), *Seslerio nitidae-Caricion macrolepidis* Ubaldi 1997, *Valeriano tuberosae-Festucion circummediterraneae* Ubaldi 2003 *nom. inval*. (art. 8), *Sideritidion italicae* (Biondi et al. 1995) Ubaldi 2011, *Knautio calycinae-Bromion caprini* Ubaldi 2011 *nom. inval.* (art. 2b, 8), *Violo pseudogracilis-Bromopsion caprini* Terzi 2011, *Phleo ambigui-Bromion erecti* Biondi, Balleli, Allegrezza et Zuccarello ex Biondi et Galdenzi 2012)

All.: Hippocrepido glaucae-Stipion austroitalicae Forte et Terzi 2005 in Forte, Perrino et Terzi 2005 [holotypus: *Acino suaveolentis-Stipetum austroitalicae* Forte et Terzi 2005 in Forte, Perrino et Terzi 2005]

Ass.:Bupleuro gussonei-Stipetum austroitalicae ass. nov. hoc loco

Nomenclature notes

The name *Cytiso-Bromion* has been considered not effectively published (art. 1) but at least the 'tableaux et figures' (tables and figures) of Bonin's thesis were effectively published, given the indication of the 'Centre Regional De Documentation Pedagogique – service d'Impression' on their cover page (Bonin 1978, Di Pietro 2011). If the name *Cytiso-Bromion* was validated by Bonin (1978), most of the scientific literature that referred to it failed to provide the place of publication correctly. The earliest *lectotypification* in accordance with the rules of ICPN gave the *Lavandulo angustifoliae-Asphodelinetum luteae* Bonin 1978 as lectotypus of the alliance (Di Pietro 2011). Regarding the rank of order, the name *Asphodelino liburnicae-Brometalia erecti* Ubaldi 2011 *nom. inval*. was invalidly published because of the lack of an unambiguous reference to the *Cytiso-Bromion* (art. 2b, note 3). The *Brometalia caprini* Ubaldi 1997 *nom. inval.* was invalidly published for the lack of a nomenclatural type of the next subordinate principal rank (art. 17). The *Festuco-Seslerietalia nitidae* 2003 *nom. inval*. was instead not validly published for the lack of an unambiguous reference to an earlier original diagnosis (art 2b) and because character, differential or diagnostic taxa were not explicitly indicated (art. 8). The last article can be quoted also for the invalid publication of the *Valeriano tuberosae-Festucion circummediterraneae* Ubaldi 2003 *nom. inval*. and *Knautio calycinae-Bromion caprini* Ubaldi 2011 *nom. inval.* Some other valid alliance names are here considered as syntaxonomic synonyms of the *Cytiso-Bromion*. However, some of them (e.g., *Seslerio-Caricion*) could be dealt with as autonomous alliances (cf. Terzi and Di Pietro 2013), depending on results of a more in-depth analysis of Italian peninsular grasslands vegetation.

Conclusion

The results obtained with this study extend the synrange of *Hippocrepido glaucae-Stipion austroitalicae* westwards up to the Pollino Massif where rocky pastures dominated by *Stipa austroitalica* were described by the new association *Bupleuro gussonei-Stipetum austroitalicae*. It seems reliable that the distribution area of the alliance is even wider, following the distribution area of its diagnostic species. *Bupleuro-Stipetum* was characterized by the predominance of Mediterranean taxa and nearly equal percentages of therophytes and hemicrytophytes. Similar life-form and chorological spectra were observed in other associations of *Hippocrepido-Stipion*. In the western part of the range, the ecological space of *Hippocrepido-Stipion* is scattered in local patches because it is compressed between the more xerothermic vegetation of *Thero-Brachypodietea* s.l. and the higher altitude vegetation of *Cytiso-Bromion*. *Hippocrepido-Stipion* and *Cytiso-Bromion* are provisionally classified within an endemic xerophytic order of the Italian Peninsula, whose correct name is *Euphorbietalia myrsinitidis*. Nonetheless, this paper highlighted the need for a syntaxonomic revision at European level of dry grassland vegetation at the southern border of the *Festuco-Brometea* to clarify the floristic relationships with the more xerothermic vegetation of *Thero-Brachypodietea* s.l. In fact, many proposals have been put forward without having been verified by means of modern statistical analyses and in the context of the European Mediterranean grasslands framework.

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On-line Suppl. Tab. 1: The *Bupleuro gussonei-Stipetum austroitalicae ass. nov. hoc loco* (relevés 1–16, *holotypus* relevés 3); vegetation of the *Cytiso-Bromion* (relevés 17–19).

Relevés	1	2	3*	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Altitude (m a.s.l.)	433	454	445	498	440	546	480	673	530	550	630	650	683	536	550	700	1028	980	1010
Exposition (°)	310	90	290	0	0	80	240	0	0	270	200	200	240	280	320	160	340	260	70
Slope (%)	25	10	30	0	0	10	20	20	0	40	40	20	20	15	25	35	10	40	25
Cover (%)	100	100	100	95	100	90	90	100	95	90	95	100	75	90	70	80	100	95	90
Plot size (m^2)	100	100	100	70	100	100	100	100	100	100	100	100	100	80	100	100	100	100	100
***Bupleuro gussonei-Stipetum austroitalicae* ass. nov.**																			
Euphorbia rigida M. Bieb.	+	+	+	+	.	1	+	+	+	+	.	+	+	+	+	+	.	.	.
Bupleurum gussonei (Arcang.) Snogerup & B. Snogerup	.	.	+	2	+	+	+	.	.	+	+	1	.	2	+	+	.	.	.
Hippocrepido glaucae-Stipion austroitalicae																			
Stipa austroitalica Martinovský subsp. *austroitalica*	5	5	5	4	5	5	5	4	4	3	4	4	4	3	3	3	.	.	.
Convolvulus elegantissimus Miller	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.	.	+
Thymus spinulosus Ten.	+	+	2	.	+	+	+	+	1	1	1	3	2	1	3	+	+	2	2
Scorzonera villosa Scop. subsp. *columnae* (Guss.) Nyman	1	+	2	+	+	2	+	+	.	+	+	+	+	+	1	+	.	.	.
Crepis rubra L.	+	+	+	+	+	+	+	.	1	+	+	.	.	+	+	+	.	.	+
Euphorbia spinosa L.	.	.	.	3	.	2	.	+	2	.	+	2	1	1	2	+	.	.	.
Stachys germanica L. subsp. *salvifolia* (Ten.) Gams	+	+	+	+	.	+	+	.	.	+	.	+	.	.	+	+	.	.	.
Rhamnus saxatilis Jacq. subsp. *infectoria* (L.) P. Fourn.	+	.	.	+	.	.	.	.	+	+	+	+	.	1	+	+	.	.	.
Hippocrepis glauca Ten.	.	.	.	+	+	.	.	+	+	.	+	+	+	+	+	.	.	2	1
Asphodelus macrocarpus Parl.	.	.	.	.	.	3	.	.	3	1	1	+	.	2	2	+	.	.	.
Melica transsilvanica Schur subsp. *transsilvanica*	.	.	.	.	.	.	.	+	+	1	+	+	.	+	2	1	.	.	+
Polygala monspeliaca L.	+	1	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Carduus nutans L. subsp. *perspinosus* (Fiori) Arènes	+	+	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla detommasii Ten.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	1
Onosma echioides (L.) L. subsp. *angustifolia* (Lehm.) Peruzzi & N. G. Passal.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Onobrychis aequidentata (Sm.) d'Urv.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cytiso spinescentis-Bromion erecti																			
Stipa dasyvaginata Martinovsky subsp. *apenninicola* Martinovsky & Moraldo	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	3
Scabiosa holosericea Bertol.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	1	+
Sideritis italica (Mill.) Greuter & Burdet	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+
Helictochloa versicolor (Vill.) Romero Zarco subsp. *praetutiana* (Arcang.) Romero Zarco	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+
Polygala major Jacq.	.	.	.	+	.	.	.	1	.	.	.	.	.	.	.	.	+	+	+
Seseli tommasinii Rchb. f.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+

Relevés	1	2	3*	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Altitude (m a.s.l.)	433	454	445	498	440	546	480	673	530	550	630	650	683	536	550	700	1028	980	1010
Exposition (°)	310	90	290	0	0	80	240	0	0	270	200	200	240	280	320	160	340	260	70
Slope (%)	25	10	30	0	0	10	20	20	0	40	40	20	20	15	25	35	10	40	25
Cover (%)	100	100	100	95	100	90	90	100	95	90	95	100	75	90	70	80	100	95	90
Plot size (m^2)	100	100	100	70	100	100	100	100	100	100	100	100	100	80	100	100	100	100	100
Helianthemum oelandicum (L.) Dum. Cours. subsp. *incanum* (Willk.) G. López	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1
Helichrysum italicum (Roth) G. Don	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	1
Cerastium tomentosum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+
Pteridium aquilinum (L.) Kuhn	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+
Crepis lacera Ten.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.
Asphodeline lutea (L.) Rchb.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Lomelosia crenata (Cirillo) Greuter & Burdet	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.
Euphorbietalia myrsinitidis																			
Koeleria splendens C. Presl	+	.	+	.	.	+	.	4	+	+	+	3	1	+	1	.	2	1	+
Cephalaria leucantha (L.) Roem. & Schult.	.	.	+	.	.	.	.	+	2	.	+	1	.	1	1	1	+	.	.
Centaurea deusta Ten.	+	.	+	+	.	+	.	+	+	.	.	.	.	+	+	.	+	.	.
Cytisus spinescens C. Presl	+	+	+	2	3	.	.	+	.	.	.	.	2	.	.	.	.	2	.
Asphodeline liburnica (Scop.) Rchb.	.	.	.	.	.	.	.	.	.	1	.	.	2	+	.	1	.	1	+
Festuca circummediterranea Patzke	2	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	2
Phleum hirsutum Honck. subsp. *ambiguum* (Ten.) Tzvelev	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	3	1	+
Elaeoselinum asclepium (L.) Bertol.	+	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+
Erysimum pseudorhaeticum Polatschek	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sedum ochroleucum Chaix subs. *mediterraneum* Gallo	.	.	.	.	.	+	.	.	.	+	.	.	+	.	.	.	+	.	.
Aethionema saxatile (L.) W. T. Aiton	.	.	.	.	.	.	+	.	.	+	.	.	+	.	.	.	+	.	.
Euphorbia myrsinites L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+
Matthiola fruticulosa (L.) Maire	+	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Pimpinella tragium Vill.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.
Thymus striatus Vahl	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Jurinea mollis (L.) Rchb.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Alyssum diffusum Ten.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Linaria purpurea (L.) Mill.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Festuco-Brometea																			
Sanguisorba minor Scop.	2	+	+	.	+	1	+	+	1	+	+	1	+	1	1	+	1	1	1
Teucrium capitatum L. subsp. *capitatum*	+	+	+	+	+	+	+	1	+	+	+	2	1	1	1	+	.	+	1

Relevés	1	2	3*	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Altitude (m a.s.l.)	433	454	445	498	440	546	480	673	530	550	630	650	683	536	550	700	1028	980	1010
Exposition (°)	310	90	290	0	0	80	240	0	0	270	200	200	240	280	320	160	340	260	70
Slope (%)	25	10	30	0	0	10	20	20	0	40	40	20	20	15	25	35	10	40	25
Cover (%)	100	100	100	95	100	90	90	100	95	90	95	100	75	90	70	80	100	95	90
Plot size (m^2)	100	100	100	70	100	100	100	100	100	100	100	100	100	80	100	100	100	100	100
Galium corrudifolium Vill.	+	+	+	2	+	1	1	.	+	+	+	+	+	+	1	+	+	+	+
Bromopsis erecta (Huds.) Fourr.	3	3	3	2	4	.	+	+	.	2	2	4	2	3	3	2	4	4	5
Petrorhagia saxifraga (L.) Link ssp. *gasparrinii* (Guss.) Greuter & Burdet	.	+	.	+	+	.	1	+	+	+	1	+	+	+	1	1	1	+	+
Anthyllis vulneraria L.	+	.	+	+	+	+	1	3	.	+	.	.	+	1	+	+	4	3	2
Phlomis herba-venti L.	+	2	.	+	+	.	+	.	+	+	1	1	1	+	+	+	.	.	.
Eryngium campestre L.	.	1	+	2	+	+	1	.	+	+	2	+	.	.	+	.	.	.	+
Teucrium chamaedrys L.	+	+	+	+	.	.	+	.	.	+	.	.	+	+	+	+	.	+	+
Eryngium amethystinum L.	+	.	+	+	.	+	.	1	+	.	.	.	.	.	+	.	1	1	1
Convolvulus cantabrica L.	.	+	+	+	+	2	1	.	+	.	+	.	.	.	.	+	.	.	.
Dianthus longicaulis Ten.	.	.	.	.	.	.	.	+	.	1	.	+	+	+	+	+	.	+	+
Carex flacca Schreb. subsp. *serrulata* (Spreng.) Greuter	.	1	.	+	2	.	+	.	.	.	.	1	.	+	+	.	.	.	1
Tragopogon porrifolius L.	+	+	+	+	+	+	.	.	.	.	+	.	.	+	.	.	.	.	.
Anacamptis pyramidalis (L.) Rich.	+	+	.	+	.	+	1	.	.	.	.	.	.	.	.	.	+	+	.
Serapias vomeracea (Burm. f.) Briq.	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla pedata Wild	.	+	+	+	.	.	+	.	.	.	.	1	.	.	+	.	.	.	.
Orchis coriophora L.	+	+	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Plantago holosteum Scop.	.	.	.	.	.	.	.	2	.	.	+	+	.	.	.	.	+	1	.
Ononis pusilla L.	.	.	.	.	+	.	.	+	.	.	.	.	+	+	.	.	.	+	.
Asperula aristata L. f subsp. *scabra* (J. Presl & C. Presl) Nyman	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	+	.	.
Helianthemum apenninum (L.) Mill. subsp. *apenninum*	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	2	2
Brachypodium rupestre (Host) Roem. & Schult.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	2	+
Sedum amplexicaule DC. subsp. *tenuifolium* (Sm. In Sibth. & Sm.) Greuter	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	1	.	+
Linum tenuifolium L.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	+	.
Lotus corniculatus L.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.	.
Medicago falcata L.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Clinopodium acinos (L.) Kuntze	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.
Silene otites (L.) Wibel	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.
Hypochaeris cretensis (L.) Bory & Chaub.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Arabis hirsuta (L.) Scop.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.

Relevés	1	2	3*	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Altitude (m a.s.l.)	433	454	445	498	440	546	480	673	530	550	630	650	683	536	550	700	1028	980	1010
Exposition (°)	310	90	290	0	0	80	240	0	0	270	200	200	240	280	320	160	340	260	70
Slope (%)	25	10	30	0	0	10	20	20	0	40	40	20	20	15	25	35	10	40	25
Cover (%)	100	100	100	95	100	90	90	100	95	90	95	100	75	90	70	80	100	95	90
Plot size (m^2)	100	100	100	70	100	100	100	100	100	100	100	100	100	80	100	100	100	100	100
Thymus longicaulis C. Presl.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.
Teucrium montanum L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
Euphrasia stricta J. F. Lehm.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Echinops ritro L.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Polygala nicaeensis W.D.J. Koch s.l.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Stachys heraclea All.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Stachys recta L. subsp. *labiosa* (Bertol.) Briq.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Stachys officinalis (L.) Trevis.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Orchis morio L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Medicago lupulina L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Serapias cordigera L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Hypochaeris radicata L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Trifolium pratense L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Pilosella piloselloides (Vill.) Soják	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Himantoglossum hircinum (L.) Spreng.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Valeriana tuberosa L.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhinanthus alectorolophus (Scop.) Pollich	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Lygeo-Stipetea																			
Dactylis glomerata L. subsp. *hispanica* (Roth) Nyman	1	1	1	1	+	+	+	.	1	+	2	+	1	+	2	+	.	.	+
Brachypodium retusum (Pers.) P. Beauv.	+	.	2	+	2	.	2	1	1	2	1	+	2	2	2	2	.	.	.
Sixalix atropurpurea (L.) Greuter & Burdet	+	+	+	+	+	.	.	+	.	.	+	+	+	+	+	+	.	+	+
Micromeria graeca (L.) Benth.	+	+	+	.	.	+	.	+	+	+	.	.	.	.	1	1	+	+	+
Hyparrhenia hirta (L.) Stapf	.	2	.	2	2	2	1	+	+	+	+	.	.	.	.	2	.	.	.
Drimia pancration (Steinh.) J. C. Manning & Goldblatt	.	+	.	+	+	.	+	.	+	+	+	.	.	+	+	+	.	.	.
Urospermum dalechampii (L.) F. W. Schmidt	+	1	+	1	.	+	+	+	.	.	.	+	.	.	.	.	.	.	.
Bituminaria bituminosa (L.) C. H. Stirt.	.	.	.	+	1	2	2	.	+	.	+	.	.	.	.	+	.	.	.
Pallenis spinosa (L.) Cass. subsp. *spinosa*	.	+	.	+	.	+	+	.	.	.	.	+	+	.	.	+	.	.	.
Ampelodesmos mauritanicus (Poir.) T. Durand & Schinz	.	.	.	.	+	.	+	.	.	.	.	.	.	.	+	.	.	.	.
Clinopodium nepeta (L.) Kuntze subsp. *glandulosum* (Req.) Govaerts	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Relevés	1	2	3*	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Altitude (m a.s.l.)	433	454	445	498	440	546	480	673	530	550	630	650	683	536	550	700	1028	980	1010
Exposition (°)	310	90	290	0	0	80	240	0	0	270	200	200	240	280	320	160	340	260	70
Slope (%)	25	10	30	0	0	10	20	20	0	40	40	20	20	15	25	35	10	40	25
Cover (%)	100	100	100	95	100	90	90	100	95	90	95	100	75	90	70	80	100	95	90
Plot size (m^2)	100	100	100	70	100	100	100	100	100	100	100	100	100	80	100	100	100	100	100
Helianthemetea guttati																			
Trifolium campestre Schreber	+	+	+	+	+	+	+	.	+	+	+	+	+	+	+	+	1	.	1
Hypochaeris achyrophorus L.	1	+	1	+	+	1	+	.	+	+	+	.	+	+	+	+	.	.	.
Briza maxima L.	+	+	+	+	.	+	+	.	+	+	+	.	+	+	+	+	.	.	.
Linum strictum s.l.	+	+	+	+	+	+	+	+	.	.	1	.	+	+	1	.	.	.	.
Catapodium rigidum (L.) C. E. Hubb.	+	+	.	+	.	+	+	.	+	+	+	.	+	+	1	+	.	.	.
Linum tryginum L.	.	+	+	.	+	.	.	+	.	+	+	+	+	.	.	1	.	.	.
Trifolium stellatum L.	+	+	+	+	+	.	+	.	.	.	.	.	.	+	.	.	+	.	.
Euphorbia exigua L.	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Filago pyramidata L.	+	+	.	.	.	.	+	.	.	.	.	.	+	+	+	.	.	.	+
Asterolinon linum-stellatum (L.) Duby	+	+	+	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.
Helianthemum salicifolium (L.) Mill.	+	+	.	+	+	.	.	.	.	+	.	.	.	.	+	.	.	.	.
Ononis reclinata L.	.	+	.	.	.	.	.	+	.	+	+	.	.	.	+	+	.	.	.
Medicago minima (L.) L.	.	.	.	+	+	+	+	.	+	.	.	.	.	.	.	.	.	.	+
Onobrychis caput-galli (L.) Lam.	.	+	.	+	+	.	.	.	+	.	.	.	.	.	+	+	.	.	.
Aira caryophyllea L.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+
Sideritis romana L. subsp. *romana*	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	+	.	.	+
Crepis neglecta L. subsp. *neglecta*	2	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.
Trachynia distachya (L.) Link	.	.	.	.	.	+	.	.	+	.	.	.	+	.	1	.	.	.	.
Crupina vulgaris Cass.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.
Lotus ornithopodioides L.	.	.	.	+	.	.	+	.	.	.	+	.	.	.	.	+	.	.	.
Plantago bellardii All.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Alyssum simplex Rudolphi	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.
Vulpia myuros (L.) C. C. Gmel.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.
Scorpiurus muricatus L.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Lagurus ovatus L.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hippocrepis biflora Spreng.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Hippocrepis ciliata Willd..	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Trigonella monspeliaca L.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.

Relevés	1	2	3*	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Altitude (m a.s.l.)	433	454	445	498	440	546	480	673	530	550	630	650	683	536	550	700	1028	980	1010
Exposition (°)	310	90	290	0	0	80	240	0	0	270	200	200	240	280	320	160	340	260	70
Slope (%)	25	10	30	0	0	10	20	20	0	40	40	20	20	15	25	35	10	40	25
Cover (%)	100	100	100	95	100	90	90	100	95	90	95	100	75	90	70	80	100	95	90
Plot size (m^2)	100	100	100	70	100	100	100	100	100	100	100	100	100	80	100	100	100	100	100
Other species																			
Carlina corymbosa L.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.	.	+	.
Bellardia trixago (L.) All.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.	.	.
Bupleurum baldense Turra	.	+	+	+	.	.	+	.	1	+	+	+	+	+	3	+	+	+	+
Crupina crupinastrum (Moris) Vis.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.	.	.	.	+
Avena barbata Link	+	+	+	+	+	+	.	.	+	+	2	+	.	+	+	+	.	.	+
Reichardia picroides (L.) Roth	+	.	+	.	+	+	+	.	+	+	.	+	+	+	+	+	.	.	+
Sherardia arvensis L.	+	+	+	+	+	+	+	.	+	.	.	.	+	+	+	+	.	.	+
Tyrimnus leucographus (L.) Cass.	+	+	+	+	+	.	+	.	.	+	+	+	+	+	+	+	.	.	.
Nigella damascena L.	+	1	1	+	+	.	+	.	+	+	+	.	.	.	+	+	.	.	.
Trifolium scabrum L. subsp. *scabrum*	.	+	+	+	+	.	+	.	+	.	+	.	.	.	+	+	+	.	+
Echium vulgare L.	+	.	+	+	+	.	.	.	+	+	.	.	+	+	+	+	.	.	+
Dasypyrum villosum (L.) P. Candargy	+	+	+	1	+	.	+	.	+	+	+	.	.	.	.	.	.	.	+
Tordylium apulum L.	.	+	.	+	.	+	+	.	+	+	+	+	.	+	+	.	.	.	.
Triticum ovatum (L.) Raspail	.	.	.	+	+	+	+	.	.	.	+	+	.	.	+	.	.	+	+
Asparagus acutifolius L.	+	+	.	.	+	+	+	.	.	+	+	.	.	.	+	+	.	.	.
Micromeria graeca (L.) Benth. subsp. *fruticulosa* (Bertol.) Guinea	+	.	+	+	.	+	+	.	.	.	+	+	+	+	.	.	.	.	.
Pistacia terebinthus L. subsp. *terebinthus*	.	+	.	+	+	+	.	.	1	+	.	.	.	2	.	+	.	.	.
Vulpia ciliata Dumort.	1	.	+	1	+	+	+	.	.	.	+	.	.	.	+	.	.	.	.
Centaurium erythraea Rafn	+	+	+	.	.	+	.	.	.	.	.	1	+	.	.	.	.	+	+
Thesium humifusum DC.	1	.	.	+	1	.	1	+	.	.	.	+	.	+	.	.	.	.	.
Seseli tortuosum L.	+	+	1	.	.	+	.	.	.	.	+	.	.	+	+	.	.	.	.
Anagallis arvensis L.	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Coronilla scorpioides (L.) W. D. J. Koch	+	.	+	.	+	+	2	.	.	.	.	.	.	.	+	.	.	.	.
Anisantha madritensis (L.) Nevski	+	1	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Medicago disciformis DC.	.	+	.	1	+	+	+	.	.	.	+	.	.	.	.	.	.	.	.
Gastridium ventricosum (Gouan) Schinz & Thell.	+	.	+	.	.	.	.	.	.	+	.	+	.	+	+	.	.	.	.
Trigonella gladiata M. Bieb.	+	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Bromus intermedius Guss.	+	+	+	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	.

Relevés	1	2	3*	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Altitude (m a.s.l.)	433	454	445	498	440	546	480	673	530	550	630	650	683	536	550	700	1028	980	1010
Exposition (°)	310	90	290	0	0	80	240	0	0	270	200	200	240	280	320	160	340	260	70
Slope (%)	25	10	30	0	0	10	20	20	0	40	40	20	20	15	25	35	10	40	25
Cover (%)	100	100	100	95	100	90	90	100	95	90	95	100	75	90	70	80	100	95	90
Plot size (m^2)	100	100	100	70	100	100	100	100	100	100	100	100	100	80	100	100	100	100	100
Cynosurus echinatus L.	.	.	.	+	+	+	.	.	+	.	+	.	.	.	+	.	.	.	.
Cardopatium corymbosum (L.) Pers.	.	1	.	+	+	.	.	.	.	.	+	3	.	.	.	.	.	.	.
Odontites luteus (L.) Clairv.	.	.	+	+	+	+	.	1	.	.	.	.	.	.	.	.	.	.	.
Poa bulbosa L.	+	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.
Ornithogalum montanum Cirillo	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stipa capensis Thunb.	.	1	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Carthamus lanatus L.	.	.	.	+	.	.	.	.	.	.	1	+	.	+	.	.	.	.	.
Ophrys tenthredinifera Willd.	1	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Allium sphaerocephalon L.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	+	.	.	.
Plantago serraria L.	+	+	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.
Trifolium angustifolium L.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	+	+	.	.	.
Blackstonia perfoliata (L.) Huds.	.	+	.	.	.	+	.	+	.	.	.	.	+	.	.	.	.	.	.
Salvia verbenaca L.	.	+	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
Althea hirsuta L.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	+	+	.	.	.
Campanula erinus L.	.	+	+	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.
Ptilostemon stellatus (L.) Greuter	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.
Fumana thymifolia (L.) Spach ex Webb	.	.	.	+	.	.	.	3	+	.	.	.	.	.	.	.	.	.	.
Rostraria cristata (L.) Tzvelev	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Allium subhirsutum L.	1	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Klasea flavescens (L.) Holub	.	.	.	.	.	.	.	.	.	.	+	1	.	+	.	.	.	.	.
Achnatherum bromoides (L.) P. Beauv.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	+	+	.	.	.
Vulpia muralis (Kunth) Nees	.	1	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+
Gypsophila arrostii Guss.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	1	.	.	.
Hypericum perforatum L.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	+
Urospermum picroides (L.) F. W. Schmidt	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Linum bienne Mill.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.
Dorycnium hirsutum (L.) Ser.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Osyris alba L.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.
Xeranthemum inapertum (L.) Mill.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+

Relevés	1	2	3*	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Altitude (m a.s.l.)	433	454	445	498	440	546	480	673	530	550	630	650	683	536	550	700	1028	980	1010
Exposition (°)	310	90	290	0	0	80	240	0	0	270	200	200	240	280	320	160	340	260	70
Slope (%)	25	10	30	0	0	10	20	20	0	40	40	20	20	15	25	35	10	40	25
Cover (%)	100	100	100	95	100	90	90	100	95	90	95	100	75	90	70	80	100	95	90
Plot size (m^2)	100	100	100	70	100	100	100	100	100	100	100	100	100	80	100	100	100	100	100
Carduus nutans L. subsp. *nutans*	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+
Asplenium ceterach L.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	.	.
Spartium junceum L.	.	.	.	.	+	.	.	.	.	+	.	+	.	.	.	.	.	.	.
Loncomelos narbonensis (Torn. in L.) Raf.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Sporadic species	4	4	5	5	3	4	3	1	1	7	6	4	4	1	2	1	8	2	3

Sporadic species: *Ajuga chamaepitys* Guss. 13 (+); *Allium flavum* L. 13 (+); *Ammoides pusilla* (Brot.) Breistr. 19 (+); *Anthemis arvensis* L. 11 (+); *Asphodelus albus* Mill. 1 (+); 12 (+); *Astragalus sesameus* L. 7 (1); 9 (+); *Bellis perennis* L. 18 (+); *Cistus creticus* L. subsp. *eriocephalus* (Viv.) Greuter & Burdet 8 (1); *Cistus monspeliensis* L. 6 (+); 14 (+); *Clematis flammula* L. 5 (+); *Crataegus monogyna* Jacq. 19 (+); *Crepis foetida* L. 6 (+); 15 (+); *Crucianella angustifolia* L. 17 (+); *Cynoglossum cheirifolium* L. subsp. *cheirifolium* 2 (+); *Delphinium halteratum* Sm. subsp. *halteratum* 1 (+); *Dianthus brachycalyx* Huet ex Bacchetta, Brullo, Casti et Giusso 17 (+); *Euphorbia peplus* L. 1 (+); *Geropogon hybridus* (L.) Sch. Bip. 4 (+); *Hedypnois rhagadioloides* (L.) F. W. Schmidt 6 (+); *Hesperis laciniata* All. 17 (+); *Knautia integrifolia* (L.) Bertol. 1 (+); 3 (+); *Leontodon rosanii* (Ten.) DC. 11 (+); *Lomelosia brachiata* (Sm.) Greuter & Burdet 4 (+); 5 (+); *Malope malacoides* L. 11 (+); 12 (+); *Malva cretica* Cav. 3 (+); *Marrubium vulgare* L. 1 (+); 13 (+); *Medicago rigidula* (L.) All. 2 (+); 4 (+); *Melica ciliata* L. 4 (+); *Odontites vulgaris* Moench 17 (+); *Ononis natrix* L. 11 (+); 12 (+); *Origanum vulgare* L. 12 (+); *Parentucellia viscosa* (L.) Caruel 18 (+); *Picris hieracioides* L. 11 (+); *Pistacia lentiscus* L. 15 (+); 16 (+); *Plantago afra* L. 11 (2); *Plantago lanceolata* L. 17 (+); *Salvia pratensis* L. s.l. 2 (+); *Scandix pecten-veneris* L. 3 (+); 17 (+); *Scorzonera hirsuta* L. 1 (+); *Scorzonera hispanica* subsp. *neapolitana* (Grande) Greuter 1 (+); 4 (+); *Sedum acre* L. 17 (+); *Sedum dasyphyllum* L. 1 (+); Silene *nocturna* 6 (+); *Silene vulgaris* (Moench) Garcke 1 (+); *Thalictrum minus* L. 1 (+); 13 (+); *Torilis nodosa* (L.) Gaertn. 2 (+); *Tripodion tetraphyllum* (L.) Fourr. 5 (+); 7 (+); *Valeriana tuberosa* L. 3 (+); *Valerianella muricata* (Stev. ex M. Bieb.) J.W. Loudon 3 (+); *Verbascum macrurum* Ten. 1 (+); 19 (+); *Vicia cracca* L. 17 (+); *Vicia sativa* L. 7 (+); *Vincetoxicum hirundinaria* Medik. 3 (+).

On-line Suppl. Appendix 1: Date and geographic coordinates of relevés in the On-line Suppl. Tab. 1: Rel. 1, 19/05/2010, 39° 49' 08'', 16° 17' 16''; Rel. 2, 19/05/2010, 39° 49' 06'', 16° 17' 18''; Rel. 3, 19/05/2010, 39° 49' 01'', 16° 17' 13''; Rel. 4, 19/05/2010, 39° 49' 16'', 16° 18' 36''; Rel. 5, 19/05/2010, 39° 49' 17'', 16° 17' 41''; Rel. 6, 19/05/2010, 39° 50' 17'', 16° 10' 51''; Rel. 7, 18/05/2010, 39° 49' 38'', 16° 16' 46''; Rel. 8, 26/06/2009, 39° 50' 15'', 16° 08' 05''; Rel. 9, 26/06/2009, 39° 50' 04'', 16° 10' 46''; Rel. 10, 25/06/2009, 39° 50' 38'', 16° 12' 4''; Rel. 11, 25/06/2009, 39° 50' 35'', 16° 12' 21''; Rel. 12, 25/06/2009, 39° 50' 36'', 16° 12' 22''; Rel. 13, 25/06/2009, 39° 50' 51'', 16° 12' 32''; Rel. 14, 25/06/2009, 39° 50' 36'', 16° 11' 03''; Rel. 15, 24/06/2009, 39° 50' 29'', 16° 11' 28''; Rel. 16, 24/06/2009, 39° 50' 35'', 16° 11' 21''; Rel. 17, 25/06/2009, 39° 51' 39'', 16° 05' 53''; Rel. 18, 26/06/2009, 39° 52' 41'', 16° 02' 55''; Rel. 19, 26/06/2009, 39° 52' 37'', 16° 03' 00''.

On-line Suppl. Appendix 2: Relevés and associations included in the dataset: Tab. 2 from Fanelli et al. (2001: *Sideritido italicae-Stipetum austroitalicae*); Tab. 96 from Brullo et al. (2001: *Chamaeleono gummiferi-Stipetum austroitalicae*); Tab. 3 and 4 from Forte et al. (2005: *Acino suaveolentis-Stipetum austroitalicae* and *Chamaecytiso spinescentis-Stipetum austroitalicae*); Tab. 13, 14, 15 and 16 from Biondi and Guerra (2008: *Convolvulo elegantissimi-Stipetum austroitalicae*, *Cardopato corymbosi-Brometum erecti*, *Centaureo apulae-Andropogonetum distachyi* and *Stipo austroitalicae-Hyparrhenietum hirtae*); Tab. 4 (rel. 1-7) from Di Pietro and Wagensommer (2008, p. 196: "Aggr. a *Ephedra nebrodensis* e *Scorzonera villosa subsp. columnae*"); Tab. 2 from Terzi et al. (2010: *Polygalo mediterraneae-Stipetum austroitalicae, Irido pseudopumilae-Scorzoneretum columnae* and *Phagnalo illyrici-Stipetum frentanae*); Tab. 1 from Di Pietro and Wagensommer (2014: *Stipo austroitalicae-Seslerietum juncifoliae*); Tab. 11 from Fascetti et al. (2013: *Anthemido columnae-Stipetum austroitalicae*).