Phytosociology of *Atractylis cancellata* and *Micromeria microphylla* communities in southern Italy with insights on the xerothermic steno-Mediterranean grasslands high-rank syntaxa

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Abstract

In the present paper a phytosociological study on the dry grassland communities identified in the western sector of the Murgia Plateau (Murgia delle Gravine) and in the Lucanian badlands territory is presented. Forty vegetation releves were carried out using the Braun-Blanquet phytosociological approach. Two new associations characterized by a therophytic dominance, namely *Lysimachio foeminae-Atractylidetum cancellatae* and *Campanulo erini-Micromerietum microphyllae*, are described and discussed from a syntaxonomic and biogeographic viewpoint. In addition, new phytosociological data concerning the *Petrosedum ochroleucum* communities developed on limestone outcrops, the perennial *Hyparrhenia hirta* steppe-like grasslands of the low-altitude areas of the Murgia hills and the small-size *Brachypodium distachyum* therophytic communities are presented.

Keywords

biogeography, limestone pavements, Mediterranean grasslands, micro-garrigue, Murgia Plateau, syntaxonomy, therophytes

Introduction

Dry grasslands habitats are an extremely interesting and variegated element of the vegetation landscape of the hilly and montane areas of the central and southern Apennines. The bioclimatic position, intermediate between the Mediterranean and the Temperate Region, the very rich species pool available and the millennial multiform pattern of land-uses contributed to the high coenological diversification we are witnessing at present (Biondi and Blasi 1984; Biondi et al. 1995; Di Pietro 2011; Apostolova et al. 2015). The grasslands of the Murgia plateau and Gravinas gorges (an area majorly laying in the Apulia Region but comprising also territories in the administrative province of Matera in the Basilicata Region) can be distinguished from those occurring in the rest of the Apennines due to a more marked floristic and cenological similarities with the western Balkans vegetation. The situation is different as regards the grassland communities that develops on the clayey substrates subjected to accelerated erosion which appear in their typical form of Badlands (locally called “calanchi”). In that case, the vegetation shows greater similarities with what is known for the driest sectors of the Mediterranean basin characterized by the dominance of pre-desert steppe species, such as *Lygeum spartum* (Brullo et al. 1990). Over the past 20 years, the phytosociological knowledge of the study area (especially of the Murgia Plateau) was significantly improved (Forte et al 2005; Biondi and Guerra 2008; Terzi and D’Amico 2008; Di Pietro et al. 2010; Terzi et al. 2010; Di Pietro and Wagensommer 2008, 2014). Currently there is a good knowledge about the most common perennial grasslands (*Acinosuaveolens*...
tis-Stipetum austroitalicae and Irido pseudopumilae-Scorzoneteretum columnae) and micro-garrigue associations (Helianthemo jonii-Corydolohymetum capitati). Instead, the coenological knowledge on therophytic grasslands still shows many gaps. In fact, the syntaxonomy of perennial and therophytic grasslands remains uncertain for the higher ranks. In this paper, new phytosociological data for five community types are presented and discussed. In particular, we formalized the proposal of two new phytosociological associations of therophytic grasslands dominated by Atractylis cancellata and Micromeria microphylla, two species which exhibit a restricted distribution in the Italian peninsula. Atractylis cancellata (Fig. 1) is a therophyte having a Mediterranean-W-Asian distribution ranging from SW-Morocco and Canary islands (the native status of the species in these islands is still doubtful) to W-Pakistan throughout the southern sector of Iberian Peninsula, S-France, S-Italy, Sicily and Sardinia, N-E Greece and North Macedonia, Turkey, all the middle-East countries, the NE sector of the Arabian Peninsula, and the coastal areas of Tunisia, Algeria, Libya and Egypt (Battandier and Trabut 1888; Pampanini 1931; Quezel and Santa 1962-63; Davis 1965-1988; Pottier-Alapetite 1979; Ozenda 1983; Benabib 2000; Boulos 2002; Fennane and Ibn Tattou 2009; López Martínez and Devesa 2014; Bammou et al. 2015; Hassler 2020; African Plant Database (version 3.4.0), Conservatoire et Jardin botaniques de la Ville de Genève and South African National Biodiversity Institute, Pretoria, "Retrieved [sept 2020]", from http://africanplantdatabase.ch). In southern Italy Atractylis cancellata occurs in the coastal and subcoastal areas of the Calabria Region and eastern Basilicata, in the Murgia plateau and Salento (Bartolucci et al. 2018). From an ecological point of view A. cancellata acts as a thermophilous species particularly resistant to drought (it occurs in the Negen and Dahna desert in Israel and Saudi-Arabia respectively) and exhibits a slight preference for neutral-alkaline soils with a significant clayey component (Pignatti et al. 2005).

Micromeria microphylla (Fig. 2) is a rare steno-Mediterranean micro-chamaephyte whose distribution range includes only Italy, Malta, Cyprus, Kriti and Libya (Pampanini 1930; Euro+Med 2006-, Brullo et al. 2020). Additional records enlarge the distribution area of M. microphylla also to few localities of Spain (Balearic Islands) (Morales 1991; Castroviejo et al. 2010) and Croatia (Flora Croatica Database: https://hirc.botanic.hr/fcd/, accessed on August 2018). In Italy, Micromeria microphylla is known for various sites of Sicily, where it is located in the Drepano-Panormitano, Agrigentino, Camarinense and Ibleo phytogeographical districts, and for Egadi and Pelagic islands (Pignatti 1982; Brullo et al. 1995; Mazzola et al. 2001; Gueli and Lo Giudice 2004; Pasta et al. 2008). M. microphylla occurs also in the Apulia Region where it was recorded for the Adriatic coastal area between Andria and Otranto, and for few limestone rocky outcrops embedded in the dry grasslands of the Hippocrepido-Stipion near Grottaglie (Murgia Area). Further records for the Italian territory come from the archeological site of “Ostia antica” in the proximity of Rome where M. microphylla is considered an adventitious species (Lucchese 1988; Lucchese and Pignatti 2013). Due to the very sporadic distribution of Micromeria microphylla in the Italian peninsula, this species was included in the Italian regional Red Lists and classified as “endangered” for the Apulia Region and as “low risk” for Sicily Region (Conti et al. 1997). However, the updated red list of plants of Apulia (Wagensommer et al. 2013) did not confirm the occurrence of M. microphylla for this Region.

Study Area

The study area (Fig. 3) encompasses two different sites. The first site concerns the western side of the Murgia plateau, an area bordering the Taranto Gulf in the Ionian side of the Apulia Region which also extends for a minor
part in the Basilicata administrative Region. Murgia is the local term for “stone” and, according to the geological literature, it identifies a wide geological unit composed of a large plateau originated by the fragmentation of the Mesozoic Apulian limestone platform. The highest culmination (Torre Disperata 686 m) places the Murgia in third place among the Apulian orographic system after the Daunian sub-Apennine (Mount Cornacchia 1190m) and the Gargano Promontory (Mount Calvo 1090m). The Ionian side of the Murgia plateau is characterized by deep vertical gorges, locally called “Gravine”.

The study area extents in the colline belt of the Murgia of Gravine, with an altitude range between 200 and 450 m.a.s.l. on substrates composed of Mesozoic limestones and Plio-Pleistocene calcareous sandstones. The second site is located in the south-eastern part of the Basilicata Region where a sequence of hills composed of Plio-Pleistocene marine clays (Bradanic foredeep) with interspersed sandy levels occur. These hills are in continuous rejuvenation by means of channel incisions resulting in the development of typical running water slope landforms known as “Calanchi” and “Biancane” (Patacca and Scandone 2007; Del Prete et al. 2008; Bentivenga et al. 2014).

From a bioclimatic standpoint (Fig. 4 and Fig. 5) the whole study areas ranges between the upper Meso-Mediterranean and lower Meso-Mediterranean thermostypes and between the upper dry and lower sub-humid umbrotypes (Blasi 2006). In terms of potential (zonal) vegetation the Murgia territory is characterized by different forest types ranging between Euphorbio apii-Quercetum trojanae of the flattish limestone plateaus, Teucrio siculi-Quercetum trojanae in the upper part of the Gravine gorges, Festuco exaltatae-Carpinetum orientalis within north-facing slopes and at the Gorges bottom and Fraxino ornii-Quercetum ilicis within the rocky steep slopes (Bianco et al. 1988; Biondi and Guerra 2008; Di Pietro and Misano 2009). The potential vegetation of the whole Lucanian Badlands area can be broadly addressed to thermophilous Quercus pubescens woods (Lauro-Quercenion pubescentis) and Mediterranean maquis shrublands (Helicotricho-Pistacietum lentisci). However, if observations were made at a smaller scale, each single badland should be considered as a single vegetation unit composed of a mosaic of permanent micro-communities. These communities are dominated, in turn, by Lygeum spartum, Atriplex halimus, Pharapholis incurva, Suaeda fruticosa, Sulla coronaria, Sulla capitata, Polygonum tenoreanum depending on micro-geomorphology and soil texture (Brullo et al. 1990; Corbetta et al. 1992; Di Pietro et al. 2010).

Data and Methods

During the period 2001-2018 40 relevés of grassland stands were carried out applying the phytosociological approach (Braun-Blanquet 1964; Westhoff and van der Maarel 1978). The plot size used in the sampling procedures was variable according to the sampled vegetation type (therophytic grasslands, micro-chamaephytic grasslands, hemycryptophytic grasslands). Taxonomic nomenclature follows the checklist of the Italian vascular flora by Bartolucci et al. (2018) while for identification and taxonomic classification reference were made to Pignatti et al. (2017-2019). Life form and chorological spectra were calculated only for the communities described as new in this paper and made reference to Pignatti (1982) and Pignatti et al. (2005). Three types of spectra were calculated according to: i) how many times a given corotype/life form occurred in the communities in issue (presence spectrum), ii) summing the frequency of each corotype/life form and multiplying this sum for the ratio between 100 and the number of relevés included in the phytosociological table (frequency spectrum) and iii) summing the average cover values (5 = 87.5; 4 = 62.5; 3 = 37.5; 2 = 17.5; 1 = 5; + = 1; r = 0.1) corresponding to each dominance-abundance Braun-Blanquet's cover index and multiplying this sum for the ratio between 100 and the number of relevés included in the phytosociological table (cover spectrum).
In the diagnosis of each plant community we have highlighted the “dominant taxa” (species showing cover-abundance higher than 3 according to the Braun-Blanquet scale in at least one of the relevés included in the phytosociological table) and the “highly frequent taxa” (species occurring in at least the 75% of the relevés of the phytosociological table). In naming the phytosociological syntaxa, we adhered to the rules of the fourth edition of the International Code of Phytosociological Nomenclature (ICPN, Theurillat et al. 2020). The syntaxonomic classification of each single species (at the rank of class) made reference to Mucina et al. (2016) and was used to build the syntaxonomic spectra of the two associations proposed as new in this paper.

Results

The field work led to the identification of five homogeneous plant communities all referring to open dry grassland and micro-garrigue habitats. Two of them, namely Lysymachio foeminae-Atractylidetum cancellatae and Campanulo erini-Micromerietum microphyllae, are here proposed as new associations. For these latter, a detailed floristic, ecological, chorological and syntaxonomic description was provided. Two communities, out of the other three communities identified, were referred to associations (Stipo australis-Hyparrhenietum hirtae, Medicago disciformis-Brachypodietum distachyi) which were already described for the study area by other authors (Biondi and Guerra 2008), while for the third community the preliminary rank of “community type” was used (i.e. Petroseum ochroleucum subsp. mediterraneum community).

Vegetation description

LYSYMACHIO FOEMINAE-ATRACTYLIDETUM CANCELLATAE Di Pietro, Fortini, Misano et Terzi ass. nov. hoc loco (Table 1)

LYSYMACHIO FOEMINAE-ATRACTYLIDETUM CANCELLATAE TYPICUM

Name - Lysymachio foeminae-Atractylidetum cancellatae typicum Di Pietro, Fortini, Misano et Terzi subass nov. hoc loco (Holotypus rel. 5, Table 1).

Characteristic taxa - Atractylis cancellata, Helianthemum salicifolium, Filago eriocephala, Lysimachia foemina.

Dominant taxa - Atractylis cancellata.

High frequency taxa - Atractylis cancellata, Helianthemum salicifolium, Filago eriocephala, Lysimachia foemina, Hippocrepis biflora.

Synecology - Therophytic communities colonizing the Pliocene clayey substrates of the Lucanian badlands and developed on extremely restricted areas (1–2 m² or even less). The Lysymachio-Atractylideto typicum (Fig. 6) acts as a poor-in-species community (average number of species per relevé = 12) which characterizes the relatively stable parts of the badland’s south-facing slopes. In particular this community is located above and below the steeper part of the badland characterized by accelerated erosion and occupied by the Camphorosmo-Lygeetum sparti Brullo et al. 1990. In this context the Lysymachio foeminae-Atractylidetum cancellatae gives rise to two separated therophytic transiction fringes between the Cam-
phorosmo-Lygeetum and the communities developed on its upper and lower sides. In most cases the communities developed at the upper side are those dominated by *Sulla coronaria* and *Scorpiurus muricatus* occurring at the top of each single badland unit. The communities developed at the *Camphorosmo-Lygeetum* lower side are generally dominated by *Parapholis incurva* and *Sulla capitata* these species finding their optimal conditions at the badland footslopes where the run-off waters tend to deposit the finest clays.

**Life forms and chorology** - Therophytes dominates in all the life forms spectra followed by the hemicryptophytes. Geophytes are completely absent and chamaephytes are very scarce. In the chorological spectrum steno-Mediterraneans dominate followed by Euro-Mediterraneans. The other chorotypes exhibit percentages always lower than 4% (Fig. 7).

**Syndynamic** - The *Lysimachio-Atractylidetum typicum* can be considered as a fragment of the micro-permanent vegetation mosaic forming the “badland system” micro-geosygetum. A reduction of the erosive action of the flooding waters leads to the rapid colonization of the space occupied by the *Lysymachio foeminae-Atractylidetum cancellatae* by the communities dominated by *Sulla coronaria* (upper part of badland) or *Sulla capitata* (lower part of badland) and subsequently by the final scrub stage of the *Helictotricho convoluti-Pistacietum lentisci* Di Pietro et Misano 2010.

**LYSYMACHIO FOEMINAE-ATRACTYLIDETUM CANCELLATAE ONONIDETOSUM RECLINITAE**

**Name** - *Lysymachyo foeminae-Atractylidetum cancellatae ononidetosum reclinatae* Di Pietro, Fortini, Misano et Terzi sub ass nov. (Holotypus: rel. 12, Table 1).

**Differential taxa of subassociation** - Ononis reclinata, Bupleurum baldense, Coronilla scorpioides.

**Dominant taxa** - Atractylis cancellata.

**High frequency taxa** - Atractylis cancellata, Helianthemum salicifolium, Filago eriocephala, Lysimachia foemina, Brachypodium distachyon, Hypochoeris achyrophorus, Euphorbia exigua, Coronilla scorpioides, Poa infirma, Crupina vulgaris, Helianthemum jonium, Fumana ericifolia.

**Synecology** - On the limestone substrates of the Murgia delle Gravine (in this case in the Gravina of Matera), this community features small pockets of soil interposed between the steppe-like grasslands and the micro-garrigues and the Mediterranean maquis communities. The most natural and long-lasting aspect of this subassociation develops where a very thin layer of soil covers the flat and more or less crackless limestone rocky surfaces. However, there are also other aspects related to the more or less disturbed areas placed on the edge of the paths created by grazing cattle trampling. Compared to the *Lysimachio-Atractylidetum typicum* occurring within the clayey Badlands area, the subass. *ononidetosum reclinatae* shows a significantly higher floristic richness (average number of species per relevé = 24). This is due to the wider pool

![Figure 6. Micro-trasect of the upper part of a badland unit: 1) *Sulla coronaria* grasslands on the stable substrates of the badland top; 2) *Atractylis cancellata* micro edges; 3) *Lygeum spartum* open grasslands in the badland sector subjected to the highest degree of erosion.](image-url)
of available annual species coming from the surrounding habitats (dry grasslands and micro-garrigues on limestone) and to the fact that the calcareous lithosols of the Murgia area are less oligotrophic than the sub-halophytic clays of the badlands.

**Life forms and chorology** - Therophytes dominates in all the life forms spectra followed by chamaephytes and hemicyryptophytic with similar percentages. In the chorological spectrum steno-Mediterraneans taxa dominate followed by Euro-Mediterraneans. The other chorotypes exhibit percentages always lower than 5% (Fig. 7).

**Syndynamic** - The progressive vegetation succession consists of a first step dominated by the *Stipa aurorita-lica* steppe-like grasslands and a second one character-
Table 1. Lysimachio foeminea-Atractyloedium cancellatae ass. nova. Typ. = Typus of the association; sT= typus of subassociation ononiotosum reclinatae; n.a.=not available; 81 is the average percentage cover in the table.

| Relevé number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | A-N |
|---------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|
| Altitude      | 360| 355| 350| 345| 342| 225| 220| 230| 325| 280| 300| 260| 275| 275| 295| 290| 280| n.a|
| Aspect        | sw| sw| sw| sw| sw| se| se| se| se| se| se| se| se| se| se| se| n.a|
| Slope         | 40| 60| 70| 70| 25| 15| 20| 0| 5| 10| 2| 5| 10| n.a|
| Area m²       | 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 81|
| Cover%        | 90| 80| 80| 90| 90| 90| 90| 75| 85| 80| 90| 90| 95| 95| 95| 95| 95| 81|

**Lysimachio foeminea-Atractyloedium typicum**

| steno-Medit | T scap | Atractylis canaliculata | 3 | 3 | 3 | 3 | 4 | 4 | 3 | 3 | 5 | 4 | 4 | 5 | 5 | 5 | 4 | V |
|-------------|--------|------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| euro-Medit  | T rept | Lysimachia foeminea     | 1 | + | 2 | + | 1 | 2 | + | + | + | + | 1 | 1 | . | . | . | . | . |
| euro-Medit  | T scap | Helianthemum salicifolium | 1 | 1 | 1 | 1 | + | + | 1 | . | + | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| steno-Medit | T scap | Anacyclus clavatus      | . | . | . | + | + | . | 1 | . | . | . | . | . | . | . | . | . | . | . |
| steno-Medit | H caesp | Elymus spartum          | + | 1 | 1 | + | + | . | . | . | . | . | . | . | . | . | . | . | . | . |
| steno-Medit | T scap | Panaphalus incurva subsp. incurvus | . | . | + | . | 1 | + | . | . | . | . | . | . | . | . | . | . | . | . |

**Lysimachio-Atractyloedium ononiotosum reclinatae**

| euro-Medit  | T scap | Ononis reclinata         | . | . | . | . | . | . | . | . | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 2 | IV |
| euro-Medit  | T scap | Bupleurum baldense       | . | . | . | . | . | . | . | . | + | 1 | 2 | 2 | . | 1 | . | . | . | . |
| euro-Medit  | T scap | Coriopsis scopariae      | . | . | . | . | . | . | . | . | + | + | 1 | + | + | . | . | . | . | . |

**Onobrycho-Petriostemion stellati**

| steno-Medit | T scap | Filago erythropoda       | . | . | + | 1 | + | 1 | + | 1 | 1 | 1 | + | + | + | . | . | . | . | . |
| steno-Medit | T scap | Catananche lutea         | . | . | . | + | 1 | . | . | . | . | . | . | . | . | . | . | . | . | . |
| steno-Medit | T scap | Sulla capitata           | . | . | . | 2 | 2 | . | . | . | . | . | . | . | . | . | . | . | . | . |
| steno-Medit | T scap | Onobrychos caespitulosa  | . | . | . | . | . | . | . | . | + | . | + | . | 1 | + | V | . | . | . |
| steno-Medit | T scap | Hypochoeris ciliosa     | . | . | . | . | . | . | . | . | + | . | . | . | . | . | . | . | . | . |

**Brachypodietalia distichyi & Stipo-Trachynietea distichyae**

| steno-Medit | T scap | Brachypodium distachyoides | . | . | . | + | 1 | + | . | 1 | 2 | 2 | 2 | 2 | 2 | 2 | + | V | . | . |
| steno-Medit | T scap | Hypochaeris achnaphorae  | 1 | 1 | . | . | . | . | 1 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 |
| euro-Medit  | T scap | Euphorbia exigua subsp. exigua | . | . | . | . | + | . | 1 | + | 1 | 1 | + | + | . | . | . | . | . | . |
| euro-Medit  | T scap | Euphorbia falata subsp. falata | . | . | . | . | + | . | 1 | . | . | . | . | . | . | . | . | . | . | . |
| euro-Medit  | T rept | Trixiolum scabrum subsp. scabrum | + | . | . | . | . | . | . | . | . | . | 1 | V | . | . | . | . | . | . |
| steno-Medit | T scap | Linum strictum           | . | . | . | + | 1 | . | . | + | . | + | . | 1 | + | V | . | . | . | . |
| SE-Europ    | T scap | Crupina vulgaris         | . | . | . | . | . | . | + | 1 | . | 1 | 1 | + | 1 | . | . | . | . | . |
| steno-Medit | T scap | Hypochoeris biflora     | . | . | . | . | . | . | + | + | . | . | + | + | . | . | . | . | . | . |
| euro-Medit  | T scap | Catapodium rigidum subsp. rigidum | + | 1 | 1 | + | 1 | + | . | . | . | . | . | . | . | . | . | . | . | . |
| steno-Medit | T scap | Hedytis thyagadioides   | . | . | . | + | . | . | + | . | . | . | . | . | . | . | . | . | . | . |
| euro-Medit  | T scap | Linaria simplex         | . | . | . | . | . | . | + | + | . | . | + | + | . | . | . | . | . | . |
| euro-Medit  | T scap | Scorpiurus munitus      | . | . | . | + | 1 | 2 | . | . | . | . | . | . | . | . | . | . | . | . |
| euro-Medit  | T scap | Malvisago minima        | . | . | . | . | . | . | + | 1 | + | 1 | . | . | . | . | . | . | . | . |

**Stipo-Trachynietea/Helianthemetea**

| steno-Medit | T scap | Ononis aromatoides       | . | . | . | . | . | . | . | . | . | . | . | 1 | 2 | . | + | . | . | . |
| steno-Medit | T scap | Festuca myuros subsp. myuros | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| steno-Medit | T scap | Ononis aromatoides       | . | . | . | . | . | . | . | . | . | . | . | 1 | 2 | . | + | . | . | . |
| euro-Medit  | T caesp | Festuca myuros subsp. myuros | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
### Table 1. Continuation.

| Relevant number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | A-N |
|-----------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|
| Altitude        | 360| 355| 350| 345| 225| 220| 230| 325| 328| 300| 260| 275| 295| 290| 280| 280| n.a|
| Aspect          |   |   |   |   |   |   |   |   |   |   | se | se |   |   |   |   | n.a|
| Slope°          | 40| 60| 70| 70| 25| 15| 20| 0| 5| 10| 2| 5| 10|   |   |   | n.a|
| Area m²         | 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5| 1.5|
| Cover%          | 90| 85| 90| 80| 90| 90| 75| 85| 90| 90| 95| 95| 95| 95| 95| 95| 95| 95| 95| 95| 95| 81|

#### Stipo-Trachyneeta/Chenopodietea

| euro-Medit | T scap | Atriplex triandra subsp. triandra |
|------------|--------|----------------------------------|
| steno-Medit | T scap | Plantago lanceolata |
| steno-Medit | T scap | Sonchus tenuissimus |
| SE-Europ   | T scap | Crepis sancta subsp. sancta |

#### Species of claye-y-slightly halophytic substrates

| steno-Medit | H scap | Salsola coronaria |
| steno-Medit | T scap | Matricaria daniica |
| SE-Europ    | Ch frut | Conophora mosqepisica |

#### Romarinetea

| steno-Medit | Ch suffr | Phacnaun napastre subsp. silvicum |
| endem.      | Ch suffr | Helianthemum joniun |
| steno-Medit | Ch suffr | Fumana thymofigia |
| steno-Medit | Ch suffr | Fumana ericofolia |
| steno-Medit | Ch frut | Eriophorum flavum subsp. flavum |

#### Lygea-Stipetea

| euro-Medit | T scap | Avena barbata |
| steno-Medit | H scap | Reichardia picroides |
| euro-Medit | H scap | Convolvulus cantabrica |
| steno-Medit | P caesp | Andropogan daatychos |
| steno-Medit | G rhiz | Aphyllanthus rosam subsp. ramous |
| SE-Europ    | T scap | Dasypyrus vilosum |
| steno-Medit | H scap | Carinia corymbosa |
| eurasiat.   | H caesp | Pot bulbosa |

#### Chenopodietea & Sisymbrietea

| steno-Medit | T scap | Trifolium neglectum |
| steno-Medit | T scap | Malvastrum aluhoru |
| steno-Medit | T scap | Brassica nigra |
| steno-Medit | T scap | Erodium malacoides subsp. malacoides |
| subcosmop   | T scap | Rorystara cristata |
| subcosmop   | T scap | Erodium cebratarum |
| euro-Medit  | T scap | Rapistrum rugosum |
| steno-Medit | T scap | Lactuca rigidus |
| euro-Medit  | T scap | Reseda phretona subsp. phretona |

#### Festuco-Brometea

| steno-Medit | G bulb | Romulea bulboidea |
| eurasiat.   | H scap | Stipa australis subsp. australis |
| endemic     | H caesp | Ornithogalum gussowii |

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Romeo Di Pietro et al.: Atractylis cancellata and Micromeria microphylla communities in southern Italy.
Table 1. Continued.

| Relevé number | Aspect | Altitude | Slope° | Area m² | Count V | Count IV | Count V | Count IV | Count V | Count IV | Count V | Count IV | Count V | Count IV | Count V | Count IV | Count V | Count IV | Count V | Count IV | Count V | Count IV | Count V |
|---------------|--------|----------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1             | 1      | 2        | 3      | 4       | 5       | 6       | 7       | 8       | 9       | 10      | 11      | 12      | 13      | 14      | 15      | 16      | A.N.    | +       | -       | -       | -       | -       | -       | -       | -       | -       | -       |
| 2             | 1      | 2        | 3      | 4       | 5       | 6       | 7       | 8       | 9       | 10      | 11      | 12      | 13      | 14      | 15      | 16      | A.N.    | +       | -       | -       | -       | -       | -       | -       | -       | -       | -       |
| 3             | 1      | 2        | 3      | 4       | 5       | 6       | 7       | 8       | 9       | 10      | 11      | 12      | 13      | 14      | 15      | 16      | A.N.    | +       | -       | -       | -       | -       | -       | -       | -       | -       | -       |
| 4             | 1      | 2        | 3      | 4       | 5       | 6       | 7       | 8       | 9       | 10      | 11      | 12      | 13      | 14      | 15      | 16      | A.N.    | +       | -       | -       | -       | -       | -       | -       | -       | -       | -       |

The Lisymachio foeminae-Atractylidetum cancellatae is an association provisionally described (sub Anagallido foeminae-Atractylidetum cancellatae) for the vegetation mosaic of the Lucanian badlands (Fascetti et al. 2001; Di Pietro et al. 2003) whose validation has never been formalized. The new samples from the Murgia territories of Apulian and Basilicata regions allowed to enlarge the distribution area and the ecological spectrum of this association that we consider as divided into two subsociations: *typicum* and *amonidetosum reclinatae*. In this paper we validate the Lisymachio foeminae-Atractylidetum cancellatae taking into account the chronology of the studies that have concerned this community over time. Accordingly, we have here established as subsociation "*typicum*" the one comprising the relevés performed on the salty-clayey substrates of the Lucanian badlands, which is the place where the association was originally (invalidly) described. Instead, the subsociation Lisymachio foeminae-Atractylidetum cancellatae *amonidetosum reclinatae* is restricted to the limestone substrates of the Murgia plateau of the Matera administrative territory.

The Lisymachio foeminae-Atractylidetum cancellatae is strictly limited to southern Italy where *A. cancellata* range extends. At present, we have no knowledge about other associations in which *A. cancellata* acts as dominant species. The only reference for the Italian peninsula is the association Atractylido-Neatostometum apuli described for western Sicily (Brullo et al. 1994) which exhibit some similarities due to a shared Brachypodietalia distachyi floristic background. However, Atractylido-Neatostometum apuli exhibits a higher sub-halophytic and xerophilous character, probably related to the rocky coastal habitats in which this association was described, and a floristic composition quite different from that of Lisymachio-Atractylidetum cancellatae (see A-N synoptic column in Table 1). In addition to the lack of Neatostoma apuli, there are other high-frequency and characteristic species of Atractylido-Neatostometum apuli that are missing in Lisymachio foeminae-Atractylidetum cancellatae (e.g., Anthemis arvensis, Anisantha fasciculata, Catapodium marinum, Kundmannia sicula, Moraea sisyrinchium, Sul-la spinosissima) which do not allow to classify our relevés under this community.
The classification of *Lysimachio foeminae-Atractylidetum cancellatae* at syntaxonomic ranks higher than association is rather complex. The ephemeral communities that develop on limestone substrates or more generally on the neutral-alkaline ones that do not have an extremely limiting factor in the mineral component of the soil tend to be dominated by a group of wide-distribution steno-Mediterranean species occurring throughout the whole Mediterranean coastal and subcoastal areas. These communities are often distinguished each other by differences in the abundance-dominance values of the species more than by the occurrence of unshared diagnostic characteristic species. As regards the classification of the *Lysimachio-Atractylidetum cancellatae* in the higher-rank syntaxa, two different options are available: i) to adopt a conservative choice considering few large-scale syntaxa well-distinguishable from a floristic and chorological point of view, ii) to opt for a more divisive choice considering a syntaxonomic framework based on a higher number of alliances having a more or less similar floristic composition. De Foucault (1999) followed this second option distributing the European therophytic dry grasslands into many alliances and orders. In our specific case, we included *Lysimachio-Atractylidetum* into the *Stipo-Trachynietea distachyae* class, whose verbal diagnosis (“Mediterranean calciphilous annual and ephemeraloid swards and grasslands”), Mucina et al. (2016) is well suited for the community in issue. As regards the rank of order, Rivas-Martinez (1978) classified *Atractylis cancellata* among the characteristic species of the order *Trachynietalia distachyae*. In contrast, Brullo et al. (2001) classified *A. cancellata* as characteristic species of the order *Stipo-Bupleuretalia semicompositi* which they considered as xerothermic variant of the *Trachynietalia distachyae*. Biondi et al. (2014) confirmed the syntaxonomic framework of Brullo et al. (2001) except for the rank of class where the *Stipo-Trachynietea* (sub: *Stipo-Brachypodietalia distachyae* (Br.-Bl. in Br.-Bl., Emeberger & Molinier 1947) Brullo 1985) was considered a later synonym of *Helianthemetea guttati* (sub: *Tuberarietea guttatae* (Br.-Bl. in Br.-Bl., Rousseau: & Négre 1952) Rivas Goday & Rivas-Mart. 1963). On the other hand, Mucina et al. (2016), who considered the *Trachynietalia distachyae* ( synonym of *Brachypodietalia distachyae*) as a strictly W-Mediterranean order, advanced the hypothesis of classifying the *Stipo-Bupleuretalia semicompositi* in the *Saginetea maritima* this order being typified by the *Plantaginio-Catapo- dion marini*, an alliance comprising the sub-halophilous therophytic communities of the coastal areas. Accordingly, Mucina et al. (2016) proposed the new order *Ptilosetemo stellati-Vulpietalia ciliatae* for “the Central and Eastern Mediterranean therophytic swards on shallow sandy and loamy soils over limestone and gypsum substrates”. In this new provisional order the authors included the following alliances: *Onobrycho-Ptilosetemonium stellati, Vulpio ciliatae-Crepidon neglectae, Xeranthemion annui, Vulpio ligusticae*. It is interesting to note that, basing on different reasons, the Prodrome of Italian Vegetation (Biondi et al. 2014) and the Eurovegchecklist (Mucina et al. 2016) considered the xerothermic therophytic communities of the central Mediterranean as belonging to an order other than *Trachynietalia distachyae* (*Brachypodietalia distachyae*). Mucina et al. (2016) based their hypothesis on biographical reasons (*Brachypodietalia distachyae* was classified as a strictly W-Mediterranean order) whereas Biondi et al. (2014) based their hypothesis on bioclimatic reasons (*Trachynietalia distachyae* would not be occurring in dry Thermo and Infra-Mediterranean bioclimates where it would be substituted by *Stipo-Bupleuretalia semicompositi*). In our opinion, the main problem is that *Stipo-Bupleuretalia* and *Brachypodietalia distachyae* exhibit a clear floristic-ecological-biogeographical overlapping. It is not by chance that De Foucault (1999) considered the alliance *Trachynion distachyae* (proposed under the new name *Sideritido-Brachypodion distachyae*) as partly belonging to the *Stipo-Bupleuretalia semicompositi* and partly to the *Trachynietalia distachyae*. The syn-chorological question is therefore to establish whether *Brachypodietalia distachyae* (= *Trachynietalia distachyae* syntax. syn.) could be a proper reference for the therophytic communities of southern Italy, considering that it was already and abundantly used for similar communities in central Italy (Filesi et al. 1996; Biondi et al. 1997; Di Pietro et al. 2002; Fanelli et al. 2010). Instead, the ecological question is to establish whether *Brachypodietalia distachyae* is sufficiently “xerophilous” to include the highly xerothermic communities of southern Italy. To answer these questions, we can do nothing but base ourselves on the original diagnosis of the syntaxa in question and on their groups of characteristic species. The order *Trachynietalia distachyae* was originally defined as including all the therophytic communities occurring throughout the Mediterranean basin on neutral-basic substrates (Rivas-Martinez. 1978). Among the characteristic species of this order are included the majority of the annual species we found in the *Lysimachio-Atractylidetum cancellatae*, such as *Atractylis cancellata, Brachypodium distachyon, Catapodium rigidum, Crupina crupinastrum, Euphorbia exigua, Linum strictum, Stachys romana* (etc.). The original diagnosis of the alliance *Trachynion distachyae* (sensu Rivas-Martinez 1978) perfectly overlapped the diagnosis of the order, as regards the chorological aspects, where instead it differed from it in ecological terms. In fact, the ecological range of the *Thero-Brachypodion* was originally defined as including only the therophytic communities distributed within the potential vegetation areas for the *Quercetalia ilicis* and the therophilous fringe of the *Quercetalia pubescenti-petraeae*. Instead, the therophytic communities developed within the potential vegetation areas for the *Pistacio-Rhamnetalia alaterni* were referred to the *Stipion retortae*. Among the characteristic species of the *Thero-Brachypodion* there are taxa (*Bupleurum baldense, Campanula erinus, Ononis reclinata*) which occur in our samples, together with taxa (*Euphorbia saluta, Dianthus nudiflorus, Hornungia petraea* and *Neotestema apulum*) which occur in Italy but not in our samples, and other taxa (the majority) which
exhibited a W-Mediterranean distribution non including Italy (e.g., Arabis parvula, Astragalus stella, Brachypodium dichotomum, etc.). On the other hand, Stipo-Bupleuretalia semicompositi is typified by a sub-halophilous coastal alliance (Sedo-Ctenopis gypsophilae), but includes also many "non halophilous" associations belonging to the thermo-Mediterranean bioclimate. In the Aspromonte massif (Brullo et al. 2001), Atractylis cancellata was reported as a high-frequency species in the communities of the alliance Onobrychido-Ptilostemonion stellati. This alliance, which included the neutral and basiphilous therophytic communities of the Intra- and Thermo-Mediterranean bioclimates was proposed as a geographical vicariant of the Stipion retortae in the central Mediterranean. However only Ptilostemon stellatus, out of the seven characteristic species designated in the diagnosis (Brullo et al. 2001), exhibits a distribution restricted to C-Mediterranean (southern Italy and W-Balkans) whereas the others (Onobrychis caput-galli, Crucianella angustifolia, Hippocrepis ciliata, Filago eriocephala, etc.) exhibited a widespread Mediterranean distribution.

The associations belonging to the Onobrychido-Ptilostemonion stellati exhibit a clear prevalence of xerophytic therophytes (e.g., Stipella capensis, Trifolium scabrum, Evax pygmaea, Ononis reclinata, Plantago lagopus) which are also common in the most of the Brachypodietalia distachyi communities. It is therefore confirmed that Brachypodietalia distachyi and Stipo-Bupleuretalia semicompositi are widely overlapping and the presumed vicariant distribution areas of these two syntaxa (i.e., Brachypodietalia distachyi in the western Mediterranean and Stipo-Bupleuretalia semicompositi in the central-eastern Mediterranean) are not consistent in floristic terms. Atractylis cancellata being originally considered a characteristic species of the Brachypodietalia distachyi and the latter order having nomenclatural priority over Stipo-Bupleuretalia semicompositi we have opted to use Brachypodietalia distachyi as a reference for Lysimachio-Atractylidetum cancellatae and to consider Stipo-Bupleuretalia semicompositi as a pro parte synonym. As regards the choice of the alliance we have decided to assign a surplus of diagnostic value (both in ecological and biogeographic terms) of the alliance we have decided to assign a surplus of diagnostic value (both in ecological and biogeographic terms) of the Onobrychido-Ptilostemonion stellati and proposed the displacement of this alliance from Stipo-Bupleuretalia semicompositi to the Brachypodietalia distachyi. The Onobrychido-Ptilostemonion stellati was originally described as an alliance not specifically linked to a particular type of substrate. For this reason, it appears as well suited to host the Lysimachio-Atractylidetum cancellatae, this association being found on different bedrock types, such as Pliocene clays, Quaternary sands, and limestones. In chorological terms the Onobrychido-Ptilostemonion stellati acts as a central Mediterranean vicariant of the W-Mediterranean Stipion retortae and the north-eastern-African Atractylido-Stipion retortae Guinocchet 1978. However, adopting a less divisive syntaxonomic interpretation, these three alliances could be brought together within a single central and western Mediterranean alliance whose nomenclatural priority would go to the Stipion retortae. In fact, precisely to the Stipion retortae made reference Guarino and Pasta (2017) in their classification of the therophytic ephemeral swales of the alkaline loamy and clayey substrates of western Sicily.

CAMPANULO ERINI-MICROMERIETUM MICROPHYLLI ass nov. (Table 2)

Name - Campanulo erini-Micromerietum microphylli Di Pietro, Misano, Fortini et Terzi ass nov. (Holotypus rel. 6, Table 2).

Characteristic taxa - Micromeria microphylia, Campanula erinus, Festuca danthonii subsp. danthonii, Festuca myuros subsp. myuros, Silene conica.

Dominant taxa - Micromeria microphylia, Medicago minima, Stipella capensis, Trifolium scabrum, Poa bulbosa, Helianthemum salicifolium, Ononis reclinata.

High frequency taxa - Micromeria microphylia, Campanula erinus, Ononis reclinata, Silene conica, Medicago minima, Erodium cicutarium, Trifolium scabrum, Stipella capensis.

Synecology - Small-size communities (1 m² or less) developed on the extremely superficial substrates of the limestone outcrops of the Murgia hills where they are found on flathill sites characterized by extremely shallow soils (1-2 cm deep) (Fig. 8). The community exhibits the co-dominance of Micromeria microphylia and various annual species. Micromeria microphylia in addition of being the syntaxon name-giving species is the only high-frequency chamaephyte occurring in the community (the
other one, *Ajuga iva*, occurs in two relevés only). Where soils are slightly deeper, the *Campanulo-Micromerietum microphyllae* tends to be colonized by taller annual grasses, such as *Stipella capensis* (sub-nitrophilous variant with *Stipella capensis*, Table 2). The preferential location of the community in environments not completely free from anthropic disturbance (especially human and animal trampling) justifies the occurrence of some sub-nitrophilous annual species, such as *Erodium cicutarium*, *Plantago lagopus*, *Rostraria cristata*, *Sonchus tenerrimus*.

**Life forms and chorology** - Therophytes dominate in all the life forms spectra. These are followed by the chamaephytes, whose high values in the cover spectrum are almost exclusively due to the contribution of *Micromeria microphylla*. In the chorological spectrum Euro-Mediterranean species dominates followed by the steno-Mediterranean ones. Surprisingly high are the percentages of the Eurasian component (Fig. 9).

**Syndynamic** - The evolution of the soils leads the *Campanulo erini-Micromerietum microphylli* to be substituted by theophytic communities of greater size, as those dominated by *Stipella capensis*, and subsequently by Mediterranean garrigues with *Corydanthum capitatus* and *Helianthemum jonium*. The final stage of the dynamic succession is a Mediterranean maquis community dominated by *Pistacia lentiscus* and *Phillyrea latifolia*.

**Syntaxonomy** - Despite the apparent floristic simplicity, the *Campanulo erini-Micromerietum microphylli* is nevertheless problematic as regards its classification at the highest ranks of syntaxonomy. The physiognomic dominance of *Micromeria microphylla*, although not overwhelming, would suggest a possible classification in the *Cisto in-canis-Ericion multiflorae*, in particular in the micro-garrigue sub-alliance *Thymo capitati-Helianthemenion jonii* Di Pietro and Misano 2010 which was described precisely in the western Murgia Plateau (Di Pietro and Misano 2010). On the other hand, the preferential location on natural calcareous pavement, and the occurrence in the community of *Petrorhagia saxifraga*, accompanied by therophytes such as *Arenaria leptoclados*, *Campanula erinus*, *Herniaria glabra*, *Silene conica*, *Sabulina tenuifolia* and *Valerianella muricata* suggest to classify the *Campanulo erini-Micromerietum microphylli* in the *Sedo-Scleranthetea*.

A third hypothesis, would be that of classifying this community in the *Trachynietea distachyae* taking into account the absolute dominance of the steno-Mediterranean therophytic component (both as number of species and cover percentage). A fourth and last option (unlike-ly in truth) would be to consider this community in the *Chenopodietea*, considering the partial anthropogenic character of the environments in which this community was found. The phytosociological literature is rather scarce as regards communities similar to the *Campanulo-Micromerietum*. In Sicily *Micromeria microphylla* is reported as a guide species of the association *Putorio calabricae-Micromerietum microphyllae* nom. inval. (Brullo and Marcenò 1979; Brullo et al.)

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**Figure 8.** 1) *Campanulo erini-Micromerietum microphyllae* on the calcareous pavements 2) *Stipella capensis* stands on deeper soils.
which was subsequently validated with the name *Micromeria microphylla-Putorietum calabricae* Brullo et Marcenò ex Terzi, Jasprica et Caković 2017 (Terzi et al. 2017). This is a chasmophytic association composed of two subassociations (*typicum* and *chiliadenetosum bocconei*) which was classified in the *Dianthion rupicolae*, an alliance endemic to southern Italy in the class *Asplenietea trichomanis* (Terzi et al. 2017, 2018). The chasmophytic behavior of *Micromeria microphylla* was also reported by Lucchesi and Pignatti (2013) who recorded the sporadic occurrence of this species within the ancient Roman walls of Ostia Antica (Rome, Italy) and hypothesized its arrival to be related with the transport of marble blocks from distant locations. The authors named the community with dominant *Micromeria microphylla* occurring on the walls of Ostia Antica simply as "*Micromeria microphylla* community" and classified it in the *Parietarietea judaicae*. However, none connection with *Asplenietea trichomanis* or *Parietarietea judaicae*, either ecological or floristic, was identifiable for the *Campanulo erini-Micromerietum microphylli* of the Murgia hills. A classification in the *Ononido-Rosmarinetea* does not seem feasible too. Although the *Ononido-Rosmarinetea* communities are abundant in the study area, especially on rocky or pebbly substrates, these are normally characterized by a clear physiognomic dominance of nano-phanerophytes and chamaephyes (Di Pietro and Misano 2010). Looking exclusively at the lithological and geomorphological characteristics of the sampled sites (fissured and flat limestone pavements), the reference to the *Sedo-Scleranthetea* would seem the most appropriate. However, observing the specific composition of the community, the most typical species of *Sedo-Scleranthetea* were absent, in particular those belonging to the genus *Sedum* and therophytes, such as *Alyssum alyssoides*, *Erophyla verna*, *Hornungia petraea*, *Saxifraga tridactylites*, *Thlaspi perfoliatum* (etc.). The dominance of steno-Mediterranean therophytes suggested us to classify the *Campanulo erini-Micromerietum microphylli* in the *Stipo-Trachynietea distachyae* (*Brachypodietalia distachyae*, *Trachynion distachyae*). In fact, although, *Micromeria microphylla* is the species displaying the highest specific cover index considering the entire phytosociological table, its cover values in several samples are comparable to those of some therophytes, such as *Campanula erinus*, *Medicago minima* or *Stipellula capensis*. Moreover, the extremely small size of *Micromeria microphylla* make this species physiognomically and functionally comparable to a small therophyte. However, the doubt in the choice between *Trachynietea distachyae* and *Sedo-Scleranthetea* is legitimate and recurrent. In particular, coenological overlaps and classification difficulties between *Sedo-Scleranthetea* and *Trachynietea distachyae* are well-known especially as regards those communities in which the dominant guide-species are therophytes (i.e., *Chaenorhino-Saxifragetum trydactylites*, *Acino-Trifolietum scabri* etc.). In our case, the situation is even more complex and would seems to be unbalanced towards the *Sedo-Scleranthetea* since the community has a micro-chamaephyte as guide-species.

**Figure 9.** Life forms, chorological and syntaxonomic spectra of the *Campanulo erini-Micromerietum microphylli* (Camp.-Micromerietum). The 3-digits codes in syntaxonomic spectra represent the class codes provided in the Eurovegchecklist (Mucina et al. 2016). Abbreviations: n. species = spectra based on presence/absence data; frequency = spectra weighted by species frequency; cover = spectra weighted by species cover-abundance.
Table 2. Campanulo erini-Micromerietum microphyllae ass. nov. Typ. = Typus of the association.

| Relevé number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---------------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|
| Altitude      | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 |
| Aspect        | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Slope*        | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Area m²       | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Cover%        | 40 | 30 | 50 | 35 | 50 | 35 | 30 | 35 | 30 | 40 | 40 | 50 | 60 | 80 |

| Steno-Medit | Typ. |
|-------------|------|
| steno-Medit T scap | Micromeria microphylla |
| steno-Medit T scap | Silene conica |
| Eurasiat T scap | Festuca danthonii subsp. danthonii |
| Euro-Medit T caesp | Festuca myuros subsp. myuros |
| steno-Medit T scap | Stipella capensis |
| Euro-Medit T scap | Medicago minima |
| Euro-Medit T scap | Trifolium pratense |
| Euro-Medit T scap | Lagurus ovatus |
| Euro-Medit T scap | Helianthemum salicifolium |
| steno-Medit T scap | Hypochaeris aequalis |
| steno-Medit T scap | Trisetaria aerea |
| Euro-Medit T scap | Crepis neglecta subsp. corymbosa |
| Euro-Medit T scap | Trifolium campestre |
| Euro-Medit T scap | Trifolium stellatum |
| Euro-Medit T scap | Calypodium rigidum |
| Euro-Medit T scap | Hippocrepis biiflora |
| Euro-Medit T scap | Trifolium repens |
| steno-Medit T scap | Stachys romana |
| steno-Medit T scap | Hedypris frigida |
| steno-Medit T scap | Medicago truncatula |
| Euro-Medit T scap | Parentucellia latifolia |
| steno-Medit T scap | Trigonella foetida |
| Euro-Medit T scap | Plantago lagopus |
| Euro-Medit T scap | Cerastium glomeratum |
| Euro-Medit T scap | Eryngium campestre |
| steno-Medit T scap | Eryngium campestre |
| Euro-Medit T scap | Centaurea erythraea |
| Euro-Medit T scap | Eryngium campestre |
| Euro-Medit T scap | Stachys germanica subsp. salvifolia |
| steno-Medit T scap | Avenaria leptocalys subsp. leptocalys |
| steno-Medit T scap | Aegopodium podagraria |
| Euro-Medit T scap | Aigusa iwa |
| Euro-Medit T scap | Ajuga chamaepitys |
| Euro-Medit T scap | Petrophragia saxifraga subsp. gasparrinnii |
| Euro-Medit T scap | Petrophragia prolifera |
| steno-Medit T scap | Salvia tenuifolia subsp. tenuifolia |
| steno-Medit T scap | Valerianella maricata |
| Eurasiat T scap | Herniaria glabra subsp. glabra |
| steno-Medit T scap | Salvia verbenaca (incl. S. clandestina) |
| steno-Medit T scap | Sisymbrium rigens |
| Euro-Medit T scap | Hypericum triquetrifolium |
| steno-Medit T scap | Triumfetta bulbosa |
| steno-Medit T scap | Poa bulbosa |
| steno-Medit T scap | Avena barbata |
| steno-Medit T scap | Cynosurus cristatus |
| steno-Medit T scap | Aegopodium podagraria |
| steno-Medit T scap | Trifolium repens |
However, the aforementioned reasons seem consistent with our choice to opt for the Stipo-Trachynietea. Fanelli (2007), in order to discriminate between the two classes emphasized on the important diagnostic role played by the bryophytic component in the Sedo-Sclerantheae communities, whereas it would be significantly lower in the Stipo-Trachynietea ones. In the case of Campanulo-Microserietum microphylli the role of the bryophytic component was found to be very low (substantially limited to a low cover percentage of Grimmia pulvinata) and this would further support our choice to classify the community in the Stipo-Trachynietea.

**STIPO AUSTROTALICAE-HYPARRHENIETUM HIRTAE** Biondi et Guerra 2008 (Table 3)

The communities dominated by *Hyparrhenia hirta* characterize the lower parts of the Murgia of Gravina and replace the grasslands dominated by *Stipa austroitalica* and *Scorzonera villosa* subsp. *columnae* of the summit areas of the Murgia plateau. These communities exhibit intermediate floristic features between three classes (*Festuco-Brometea, Lygeo-Stipetea* and *Festuco hystricis-Olynoideae*), and testify the coenological transition between the Apennine-Balkan biogeographical province (Euro-Siberian Region) and the Adriatic province (Mediterranean Region). This transition is clearly observable moving from the summit areas of the Murgia plateau, still affected by cold winds from north-eastern Europe, to the lowlands facing the Taranto Gulf where the influence of the warm winds of south-western origin occurs. *Hyparrhenia hirta* is absolutely the dominant species of these xerothermic steppe-like communities especially when developed on partially leached soils rich in fine debris. *Stipa austroitalica* is constantly occurring in the dominant tall grasses layer, whereas *Scorzonera villosa* subsp. *columnae* do the same in the undergrowth. In addition, the *Hyparrhenia hirta* communities host some species typical of the Hippocrepido-Stipion austroitalicae dry-grasslands (*Festuco-Brometea* such as *Hippocrepis glauca*, *Anthyllis vulneraria* subsp. *rubriflora*, *Convolutus elegantissimus*). The steno-Mediterranean and Euro-Mediterranean component however remains dominant and would justify the classification of this community in the *Lygeo-Stipetea, Hyparrhenietalia hirtae* and *Hyparrhenion hirtae* as already proposed in Biondi and Guerra (2008). As regards the rank of order we object to a purely nomenclatural question, namely we have followed Mucina et al. (2016) which consider *Cymbopogono-Brachypodietalia ramosi* to be a prior syntaxonomic synonym of *Hyparrhenietalia hirtae* Rivas-Mart. 1978 (nom. inval.). Instead, the choice of the alliance is a more complex question. *Hyparrhenion hirtae* and *Cymbopogono-Brachypodion ramosi* are both accepted in the Eurovegchecklist as geographically vicariant alliances, the first occurring in the western Mediterranean and the southern Regions of the central Mediterranean whereas the second being restricted to the eastern Mediterranean. In our opinion, the classification of the *Stipo austroitalicae-Hyparrhenietum* should be based on comparing the floristic-coenological characteristics of the sampled communities with the original diagnoses of the two aforementioned alliances. Accordingly, we noticed that our *Hyparrhenia hirta* grasslands are characterized by the simultaneous occurrence of two taxa (*Stipa austroitalica* and *Scorzonera villosa* subsp. *columnae*) belonging to the *Stipa pennata* s.l. and *Scorzonera villosa* s.l. collective taxa respectively. This is a typical feature of the eastern Adriatic Mediterranean steppe-like grasslands too, where the two taxa in issue are *Scorzonera villosa* subsp. *villosa* and *Stipa eriocaulis*. Moreover, in the *Stipa austroitalicae-Hyparrhenietum hirtae* occur East-European or amphip-Adriatic species (*Dasypyrum villosum*, *Charybdis pancratium*, *Hippocrepis glauca*, *Melica transsylvanica*, *Thapsia garganica*, *Asyneuma limonifolium*, *Centarea deusta*, *Ornitoghalum gussonei*) which are species not included in the *Hyparrhenion hirtae* range. For this reason, we classified the *Stipo austroitalicae-Hyparrhenietum* in the *Cymbopogono-Brachypodion ramosi*. However, considering that the above-mentioned differential species of *Stipo-Hyparrhenietum* are all belonging to classes other than *Lygeo-Stipetea*, a different framework could be hypothesized. In practice it would be a question of considering a single Mediterranean alliance for both “eastern” and “western” *Hyparrhenia hirta* communities and delegating possible biogeographic differentiation to the lower taxonomic ranks, such as suballiances or associations.

This consideration would be also supported by the fact that the species which were originally considered as characteristic species of both *Cymbopogono-Brachypodion ramosi* and *Cymbopogono-Brachypodietalia ramosi* (Allium sphaerocephalon, *Briza maxima*, *Cruceanella lattifolia*, *Heteropogon contortus*, *Hyparrhenia hirta*, *Medicago minima*, *Lagarus ovatus*, *Linum strictum* and *Lotus edulis*), display a wide Mediterranean distribution and do not suggest differential *Cymbopogono-Brachypodion ramosi* as an alliance restricted solely to the central-eastern Mediterranean. The situation does not change even adding the species considered by Horvatić (1973; 1975) as transgressive or invasive in *Cymbopogono-Brachypodietalia ramosi* (e.g., *Allium subhirsutum*, *Bituminaria bituminosa*, *Carex divulsa*, *Clinoodium nepeta*, *Filago germanica*, *Hedypnois rhagadioloides*, *Hymenocarpus cirratus*, *Latus ornithopodioides*, *Olopium miliaceum*, *Scorpiurus subvillosus*, *Trifolium angustifolium*, *Trifolium scabrum*). In fact, more than the list of characteristic species of *Cymbopogono-Brachypodion*, it was the great biogeographic selectivity of the characteristic species of the *Hyparrhenion hirtae* (see Diaz-Garretas and Asensi 1999) that discouraged *Hyparrhenia hirtae* to be used as taxonomic reference for our relevés. In addition to species occurring throughout the whole Mediterranean basin (e.g. *Andropogon distachyos*, *Hyparrhenia hirta*, *Heteropogon contortus*, *Bothriochloa ischaemum*, *Convolutus althaeoides*), the *Hyparrhenion hirtae* exhibits characteristic species which are strictly western Mediterranean (*Daucus crinitus* and *D. setifolius*) or species not occurring in the Adriatic area (*Aristida adscensionis*, *Carex depressa*, *Tricholaena teneriffae*), or not occurring in It-
### Table 3. Stipo aurostralianae-Hyparrhenietum hirtae Biondi et Guerra 2008.

| Relevé number | 1 | 2 | 3 | 4 | 5 |
|---------------|---|---|---|---|---|
| Altitude      | 300| 310| 315| 280| 290|
| Aspect        | WSW| W  | SW | SSW| W |
| Slope°        | 10 | 10 | 10 | 10 | 10 |
| Area m²       | 30 | 30 | 30 | 30 | 30 |
| Cover%        | 80 | 85 | 75 | 85 | 90 |

#### Stipo aurostralianae-Hyparrhenietum hirtae

| Sex      | Height | Species                                      |
|----------|--------|---------------------------------------------|
| endemic  | H caesp| Stipa aurostraliana subsp. aurostraliana    |
| Eurasian | H caesp| Hyparrhenia hirta                          |
| steno-Medit | T scap| Briza maxima                                |
| steno-Medit | T scap| Linum strictum subsp. strictum              |
| Euro-Medit | H scap| Bituminaria bituminosa                      |
| Euro-Medit | T scap| Lagurus ovatus subsp. ovatus                |
| steno-Medit | T scap| Hedypnus rhagadioideis                     |
| Euro-Medit | T scap| Lotus ornitopodioides                       |
| Euro-Medit | T rept | Trifolium scabrum subsp. scabrum             |

#### Lygeo-Stipetea

| Euro-Medit | T scap | Avena barbata                                |
| steno-Medit | G bulb | Allium tenuiflorum                           |
| steno-Medit | H scap | Reichardia pircoides                         |
| Euro-Medit | G bulb | Charybdis pancration                         |
| steno-Medit | H scap | Thapsia garganica                            |
| steno-Medit | H caesp| Daucylium glomerata subsp. hispanica         |
| steno-Medit | T scap | Lotium rigidum                               |
| Euro-Medit | H caesp| Melica ciliata                               |

#### Stipo-Trachymetea

| steno-Medit | T scap | Crupina crupinastrum                        |
| steno-Medit | T scap | Polygala monspeliaca                        |
| steno-Medit | T scap | Rostraria hispida                           |
| Euro-Medit | P caesp| Festuca danthonii subsp. danthonii          |
| Euro-Medit | H scap | Uropsernum dalechampii                      |
| steno-Medit | T scap | Hippocrepis ciliata                          |
| steno-Medit | T scap | Hypochoeris aegyptorhous                    |
| Euro-Medit | T scap | Ononis reclinata                             |
| steno-Medit | T scap | Stipella capensis                           |
| Euro-Medit | T scap | Cornilla scorpiodes                          |
| Euro-Medit | T scap | Euphorbia falcata subsp. falcata             |
| Euro-Medit | T scap | Helianthemum salicifolium                   |
| steno-Medit | T scap | Linum corymbulosum                          |
| steno-Medit | T scap | Stachys romana                              |
| Eurasian    | T scap | Centaurium tensiflorum subsp. tensiflorum    |
| steno-Medit | T scap | Brachypodium distachyom                     |
| Euro-Medit | T scap | Trifolium stellatum                         |
| Euro-Medit | T scap | Trigonella monspeliaca                      |
| Eurasian    | T scap | Trifolium campestray                         |

#### Festuco-Brometea & Molinio-Arrhenatheretea

| SE-Europ   | G bulb | Scorzonera villosa subsp. columnae          |
| steno-Medit | H scand| Convulvalus elegantisissimus               |
| steno-Medit | T scap | Thapsia aestivalis                         |
| Euro-Medit | G bulb | Anacamptis pyramidalis                    |
| steno-Medit | T scap | Anthyllis vulneraria subsp. rubriflora     |
| Eurasian   | H bien | Centaurium erythraei subsp. erythraei      |
| SE-Europe  | H caesp| Hippocrepis gauca                           |
| Euro-Medit | G bulb | Allium vineale                              |
| Euro-Medit | H scap | Asynema linornifolium                      |
| endemic    | H bien | Centaurea deusta                           |
| Euro-Medit | H scap | Eryngium campestrae                        |
| Euro-Medit | G bulb | Anacamptis coriophora                      |
| Eurasian   | H scap | Poterium sanguisorba subsp. balearicum     |
| Euro-Medit | T scap | Blackstonia perfoliata subsp. perfoliata   |
| Eurasian   | H bien | Daucus carota                               |
| Euro-Medit | G bulb | Muscari comosum                            |
| steno-Medit | G bulb | Ornithoghalum gussonei                     |
| steno-Medit | H bien | Sisylx atropurpurea                         |

#### Ononio-Rosmarinetea

| steno-Medit | Ch suffr| Teucrium capitatum subsp. capitatum         |
| steno-Medit | Ch suffr| Micromeria graeca                           |
| steno-Medit | P caesp| Cistus creticus subsp. eriocephalus         |
| steno-Medit | Ch suffr| Euphorbia spinosa                           |
| endemic    | Ch suffr| Helianthemum jonium                         |
| steno-Medit | H caesp| Cistus salviolus                            |
Table 3. Continuation.

| Relevè number | 1 | 2 | 3 | 4 | 5 |
|---------------|---|---|---|---|---|
| Altitude      | 300| 310| 315| 280| 290|
| Aspect        | WSW| W | SW | SSW| W |
| Slope°        | 10 | 15 | 5  | 10 | 15 |
| Area m²       | 90 | 30 | 30 | 30 | 30 |
| Cover%        | 80 | 85 | 75 | 85 | 90 |

| steno-Medit   | Ch suffr | Fumana thymifoia | + | .  | .  |
| steno-Medit   | Ch suffr | Satureja montana  | . | .  | 1  |

**Chenopodietae & Artemisietae**

Euro-Medit

|  | T scap | Bellardia trissago | . | +  | 1  |
|  | T scap | Koenenia integrifolia subsp. integrifolia | 2 | +  | 1  |
|  | T scap | Nigeria damascena   | . | +  | 1  |
|  | T scap | Helminthotheca echioides | 1 | 1  | .  |
| steno-Medit   | T scap | Anthemeris arvensis subsp. incrassata | 1 | .  | +  |
| steno-Medit   | H scap | Carlinia corymbosa   | . | +  | 1  |
| Euro-Medit    | T scap | Dasyxylon villosum   | 2 | .  | +  |
| steno-Medit   | T scap | Orlaya daucoides     | . | 1  | .  |
| Euro-Medit    | T scap | Pallenis spinosa subsp. spinosa | . | +  | .  |
| steno-Medit   | T scap | Triticum neglectum   | . | +  | 1  |
| steno-Medit   | T scap | Ammoidsas passila    | . | .  | .  |
| Eurosiai      | H bien | Lactuca viminea subsp. viminea | . | +  | .  |
| Euro-Medit    | H scap | Pectis hieracioides subsp. hieracioides | 1 | .  | .  |
| steno-Medit   | T scap | Reseda alba subsp. alba | . | +  | .  |
| Eurosiai      | H scap | Silene vulgaris      | + | .  | .  |
| steno-Medit   | T scap | Linum decumbens      | + | .  | .  |
| steno-Medit   | T scap | Tyrimes leucographus  | . | +  | .  |

**Quercetia ilicis (Pistacio-Rhamnetalia)**

| steno-Medit   | P caesp | Pistacia lentiscus    | . | +  | +  |
| steno-Medit   | P caesp | Asparagus acutifolius | + | .  | +  |
| steno-Medit   | P caesp | Daphne gnidiun       | . | .  | +  |
| steno-Medit   | P caesp | Olea europaea var. sylvestris | . | +  | +  |
| SE-Europ      | P caesp | Rhamnus saxatilis    | . | 1  | .  |

**Sedo-Scleranthetae**

| Euro-Medit    | H caesp | Petrophagia saxifraga subsp. gasparinii | + | .  | .  |
| Euro-Medit    | T scap | Reseda phytusea subsp. phytusea | 1 | 1  | .  |
| Euro-Medit    | Ch succ | Petoecemum ochroleucum subsp. mediterraneum | + | .  | .  |
| Eurosiai      | H caesp | Poa bulbosa          | . | .  | +  |

...
Table 4. *Medicago disciformis-Brachypodietum distachyi* Biiondi et Guerra 2008 (rels 1–4); *Lagurus ovatus* community (rels 5–6).

| Relevé number | 1 | 2 | 3 | 4 | 5 | 6 |
|---------------|---|---|---|---|---|---|
| Altitude x 10 | 28 | 28 | 30 | 30 | 30 | 31 |
| Aspect | SW | SSW | - | - | - | - |
| Slope | 3 | 3 | - | - | - | - |
| Area m² | 2 | 2 | 2 | 2 | 2 | 2 |
| Cover% | 90 | 85 | 85 | 80 | 85 | - |

 Medicago disciformis-Brachypodietum distachyi

| T scap | steno-Medit | Brachypodium distachyon | 4 | 3 | 2 | . |
| T scapo | Euro-Medit | Medicago disciformis | + | + | + | . |
| T scapo | steno-Medit | Lagurus ovatus & Anisantha madritensis comm. | . | . | + | 3 |
| T scapo | Euro-Medit | Euro-Medit | . | . | + | 2 |

Brachypodion distachii

| T scapo | steno-Medit | Campanula erinus | . | . | 2 | + |
| T scapo | Euro-Medit | Euphorbia esigua subsp. esigua | + | + | + | + |
| T scapo | Euro-Medit | Bupleurum baldense | 1 | + | + | . |
| T scapo | Euro-Medit | Ononis reclinata | . | + | + | . |

Brachypodietalia distachyi; Stipo-Trachynietea

| T scapo | steno-Medit | Ononis ornithopodioides | 1 | + | 1 | + |
| T scapo | Euro-Medit | Lychnis foemina | . | + | + | - |
| T scapo | Euro-Medit | Helianthemum salicifolium | + | + | + | + |
| T scapo | steno-Medit | Hypecothorae acyclorhous | 1 | . | + | + |
| T caesp | Euro-Medit | Festuca dantchioni subsp. dantchioni | + | 1 | + | . |
| T scapo | Euro-Medit | Filago pyramidalis | + | + | + | - |
| T scapo | steno-Medit | Linum strictum subsp. strictum | 2 | 2 | + | . |
| T scapo | Euro-Medit | Onobrychis caput-galli | 1 | 2 | + | + |
| T rept | Euro-Medit | Trifolium scabrum subsp. scabrum | 1 | 2 | + | + |
| T scapo | Euro-Medit | Catapodium rigidum | . | + | . | . |
| T scapo | Eurosia | Centaureum tenuiflorum subsp. tenuiflorum | 1 | + | + | . |
| T scapo | Euro-Medit | Gynosurus echinatus | + | . | 1 | . |
| T rept | steno-Medit | Filago asterisciflora | 1 | 1 | - | . |
| T scapo | steno-Medit | Hippocrepis ciliata | 1 | 1 | - | . |
| T scapo | Euro-Medit | Medicago minima | 1 | 1 | - | . |
| T scapo | steno-Medit | Stachys romana | + | - | + | . |
| T scapo | steno-Medit | Trifolium infaunaria-ponertii | + | + | + | . |
| T scapo | Euro-Medit | Trifolium stellatum | + | + | + | . |
| T caesp | Euro-Medit | Festuca myuros subsp. myuros | . | 1 | - | + |
| T scapo | steno-Medit | Briza maxima | . | . | 1 | - |
| T scapo | steno-Medit | Crupina crupinastrum | + | . | - | . |
| T rept | steno-Medit | Filago pyramidalis | + | . | - | . |
| T scapo | Euro-Medit | Hippocrepis biflora | . | + | - | . |
| T scapo | steno-Medit | Polypogon monspeliaca | . | + | - | . |
| T scapo | Eurosia | Trifolium campestre | + | . | - | . |
| T scapo | steno-Medit | Plantago lagopus | + | 1 | - | . |
| T scapo | Euro-Medit | Crepis neglecta | . | . | 1 | 2 |

Chenopodietea

| T scapo | steno-Medit | Lysimachia arvensis subsp. arvensis | 1 | . | + | . |
| T scapo | Euro-Medit | Dasypyrus villosus | . | + | + | - |
| T scapo | Euro-Medit | Triticum neglectum | 2 | 2 | - | . |
| T scapo | Euro-Medit | Carthamus lanatus | . | - | - | + |
| T scapo | Euro-Medit | Plantago coronopus subsp. coronopus | . | + | - | . |

Sedo-Scleranthetea

| T scapo | steno-Medit | Gastridium ventricosum | . | + | - | . |
| H caesp | Euro-Medit | Petrophila saxifraga subsp. gasparrinii | . | + | - | . |
| CH succ | Euro-Medit. | Petroseum ochroleucum subsp. mediterraneum | . | + | . | + |
| CH succ | Euro-Medit | Sedum album | + | . | - | . |
| T scapo | steno-Medit | Valantia muralis | . | 1 | - | . |

Lygeo-Stipeae

| T scapo | Euro-Medit | Avena barbata | . | . | - | . |
| H scapo | Euro-Medit | Coryolus cantabricus | . | 1 | . | . |
| H scapo | steno-Medit | Thanopsis garganica | . | + | - | . |
| T par | Euro-Medit | Cuscuta filiformis | . | + | - | . |

Poetae bulbosae

| H caesp | Eurosia | Poa bulbosa | 1 | 1 | - | . |

Festuco-Brometea

| H caesp | endemic | Koeleria splendens | . | + | - | . |

Ononio-Rosmarinetea

| CH suffr | steno-Medit | Teucrium capitatum subsp. capitatum | + | . | - | . |
| CH rept | SE-Europ | Thymus spinulosus | 1 | 1 | - | . |
| CH suffr | steno-Medit | Fumana thymifolia | 1 | - | - | . |
Coronilla scorpoides. In particular, the therophytic communities of the Murgia hills were included in the suballiance Ononidion ornithopodioidis Biondi & Guerra 2008 whose differential species were selected in Ononis ornithopodioides, Trifolium lucanicum, Bromus fasciculatus, Odontites lutea, Ammoids pusilla, Romulea bulbocodium and Convulvulus elegansissimus. In our opinion, the whole characteristic component of the Hypochaeridion achyrophori does not identify any geographical peculiarity since all the characteristic species display a wide Mediterranean distribution. Accordingly, we don’t think there is any reason to distinguish floristically and biogeographically Hypochaeridion achyrophori from the Trachynion distachyi. According to Mucina et al. (2016) the Hypochaeridion achyrophori, as well as being invalid, is to be considered a taxonomic synonym of Vulpio ciliatae-Crepидion neglectae Poldini 1989. Where small depressions are formed on the limestone crust with greater soil coverage, especially in areas where the passage of grazing animals is more frequent, annual species with slightly more anthropogenic character, such as Anisantha madritensis and Lagurus ovatus take over as dominant (Table 4, rels 5–6). In taxonomic terms, these communities can be interpreted as the transition between Brachypodietalia distachyi and Brometalia rubenti-rectorum (Chenopodietea).

**Table 5. Petrosedum ochroleucum community.**

| Relevé number | 1 | 2 | 3 | 4 | 5 |
|---------------|---|---|---|---|---|
| Altitude      | 300 | 310 | 315 | 300 | 295 |
| Slope*        |   |   |   |   |   |
| Area m²       | 85 | 90 | 85 | 80 | 85 |
| Cover%        |   |   |   |   |   |

**Petrosedum ochroleucum subsp. mediterraneum community**

| Euro-Medit | CH succ | Petrosedum ochroleucum subsp. mediterraneum | Sedo-Scleranthetea | Sedo ochroleuci-Saturejetum cuneifoliae |
|------------|---------|------------------------------------------|--------------------|----------------------------------------|
| steno-Medit | T scap  | Campanula erinus                          |                    |                                        |
| Euro-Medit  | T scap  | Linaria simplex                           |                    |                                        |
| steno-Medit | T scap  | Valantia muralis                          |                    |                                        |
| SE-Europ    | T scap  | Bromus madritensis                        |                    |                                        |
| Euro-Medit  | T scap  | Crapina vulgaris                          |                    |                                        |
| steno-Medit | T scap  | Lysimachia foemina                        |                    |                                        |
| Euro-Medit  | T scap  | Briza maxima                              |                    |                                        |
| steno-Medit | T scap  | Catapodium rigidum                        |                    |                                        |
| steno-Medit | T scap  | Hypochaeris achyrophorus                  |                    |                                        |
| steno-Medit | T scap  | Brachypodium distachyon                   |                    |                                        |
| steno-Medit | T scap  | Hedypnois rhagadioloides                  |                    |                                        |
| Euro-Medit  | T scap  | Helianthemum salicifolium                |                    | 1                                      |
| Euro-Medit  | T scap  | Hippocrepis biflora                       |                    | +                                      |
| steno-Medit | T scap  | Linum strictum subsp. strictum           |                    | +                                      |
| Euro-Medit  | T scap  | Ononis reclinata                          |                    |                                        |
| steno-Medit | T scap  | Plantago lagopus                           |                    |                                        |
| Euro-Medit  | T caesp | Festuca danthonii subsp. danthonii        |                    |                                        |
| Euro-Medit  | T caesp | Festuca myuros subsp. myuros             |                    |                                        |
| Euro-Medit  | T scap  | Lagurus ovatus subsp. ovatus              |                    |                                        |
| steno-Medit | T scap  | Fumana ericifolia                         |                    |                                        |
| Endem       | CH sufr | Helianthemum jonium                       |                    | 1                                      |
| paleotemp.  | H caesp | Poa bulbosa                               |                    | 1                                      |

In environmental situations of undulating rocky outcrops characterized by micro-depressions in the calcareous plateau profile, communities with a clear dominance of Petrosedum ochroleucum subsp. mediterraneum accompanied by a few other chamaephytes and a rich therophytic component are found. The degree of vegetation cover is quite high as there are very few parts of the sampling plots not covered by a thin layer of soil at least. From a taxonomic point of view, the coenologial role of Petrosedum ochroleucum was already known in the study area, this taxon being one of the guide species of the association Sedo ochroleuci-Saturejetum cuneifoliae already described for the small-size terraces bordering the Gravina gorges (Di Pietro and Misano 2010). However, this reference cannot be used for our relevés the habitat type of the Sedo-Saturejetum cuneifoliae being quite different and Satureja cuneifolia being completely absent in our relevés. In the Italian peninsula, other communities dominated by species belonging to the genus Petrosedum have already been described, such as the Sedetum rupestris-seangulatis Di Pietro et al. 2006 of the Prenestini mountains in the Lazio region pre-Apennines (Di Pietro et al. 2006) and the Linario purpurea-Petrosedetum rupestris Ciaschetti et al. 2020 of the hilly and lower-montane belts of the Abruzzo.
Apennines (Ciaschetti et al. 2020). However, both these communities have different guide species (e.g., Petroseum rupestris) and exhibit quite different floristic compositions compared with those of the Apulian communities. A suitable syntaxonomical reference already published not being available and our relevés being too few to propose a new association, we preferred to preliminary name this community simply as Petroseum ochroleucum subsp. mediterraneum comm. In terms of higher syntaxonomical ranks, the most plausible references are Alysso-Sedion, Alysso-Sedetalia and Sedo-Scleranthetea.

Conclusions

In this paper, two new associations were identified and described for the south-eastern sector of Peninsular Italy, namely the xerophytic annual grasslands and micro-garrigues dominated by Atractylis cancellata and Micromeria microphylla. These taxa are two S-Mediterranean species whose Italian distribution is restricted to southern Italy and for which very scarce phytosociological references were available. Moreover, new phytosociological data and syntaxonomical insights were provided on other types of Mediterranean dry grasslands and micro-garrigues, identified in the study area. The new association Campanulo erini-Micromerietum microphyllae was classified in the class Stipo-Trachynietea this choice representing a novelty for the communities dominated by Micromeria microphylla, for which the only references available at present were the classes Parietarietum judaicae and Asplenieta trichomanis. The new association Lysymachio foeminae-Atractylidetum cancellatae was here classified in the alliance Onobrychido-Ptilostemonion stellati (that we moved from Stipo-Bupleuralia semicompositi to Brachypodietalia distachyi). This alliance substitutes the W-Mediterranean Stipion retortae and the S-Mediterranean Atractylido-Stipion retortae in encompassing the most xerothermic fringe of the order Brachypodietalia distachyi in southern Italy. At the same time, we have still considered the occurrence of Trachyniot distachyi in our study area classifying in this alliance the association Medicago disciformis-Brachypodietum distachyi. In our opinion, in southern Italy there is an overlap between the ephemeral communities of the Meso-Mediterranean belt coming from the coastal sectors of central-northern Italy and those of the dry-Thermo-Mediterranean belt coming from the pre-desert areas of the south-eastern Mediterranean. For this reason the identification and separation of two different alliances (Trachyniot distachyi and Onobrychido-Ptilostemonion stellati) in the study area was not easy as these two alliances shared a large part of their therophytic component. As a useful tool for classification we reiterared the diagnostic importance expressed by the guide species (dominant species) of a community. In our opinion, the physiognomical dominance of a given species should not exclusively be interpreted as the response to the current environmental conditions but also as the result of previous epionthological processes. For this reason, the dominant species should express a syntaxonomical diagnostic power (especially when the syntaxonomical debate is about the choice of order or class) greater than what would be assigned to it based on its mere presence in the community. In our specific case of the Lysimachio-Atractylidetum cancellatae, the dominance of Atractylis cancellata was considered as the sign of previous occurrences of a xerothermic Irano-Turanian pre-desertic vegetation that migrated in southern Europe from the Messinian Age on. This interpretation is in accordance with the spatial contact of Lysimachio-Atractylidetum cancellatae with the perennial Lygeum spartum or Hyparrhenia hirta communities and with transitional stages tending to potential vegetation types belonging to Pistacio-Rhamnetalia alatieri. Our syntaxonomical choices, however, cannot solve the problem the floristic similarities between the Onobrychido-Ptilostemonion stellati and the Trachyniot distachyi. In fact, despite being alliances belonging to different orders, they share a large part of their characteristic species. Accordingly, we will address the resolution of this syntaxonomic question for future researches to be carried out using a much larger amount of phytosociological data from the entire Mediterranean basin. Basing on biogeographic and nomenclatural reasons, the association Stipo australiaca-Hyparrhenietum hirtae was classified in the Cymbopogono-Brachypodietalia ramosi and Cymbopogono-Brachypodion ramosi although the floristic and ecological boundaries between the latter alliance and the W-Mediterranean alliance Hyparrhenion hirtae still remain undefined.

Some points of discussion raised in this paper turned out to be only partially in agreement with the frameworks provided by both the Vegetation Prodrome of Italy (Biondi et al. 2014) and the Eurovegchecklist (Mucina et al. 2016) leaving open the way to possible proposals for syntaxonomical changes in the future.

Syntaxonomical scheme

STIPO-TRACHYNIETEA DISTACHYAE Brullo in Brullo et al. 2001
BRACHYPIDETALIA DISTACHYI Rivas-Mart. 1978
[= Trachynietalia distachyi Rivas-Mart. 1978 nom. mut. propos.; Stipo-Bupleuretalia semicompositi Brullo in Brullo et al. 2001 synt. syn. p.p.]
Trachyniot distachyi Rivas-Mart. 1978
Medicago disciformis-Brachypodietum distachyi Biondi et Guerra 2008
Lagarus ovatus and Anisantha madritensis comm. Onobrychido-Ptilostemonion stellati Brullo et al. 2001
Lysimachio foeminae-Atractylidetum cancellatae ass. nova
Campanulo erini-Micromerietum microphylli ass nova
SEDO-SCLERANTHETEA Br.-Bl. 1955
ALYSSEO-SEDETALIA Moravec 1967
Alysso alyssoidis-Sedion Oberd. et T. Müller in T. Müller 1961
Petroseum ochroleucum subsp. mediterraneum

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[152]
LYGEO SPARTI-STIPETEA TENACISSIMAE Rivas-Mart.1978  
CYMBOPOGONO-BRACHYPODIETALIA RAMOSI Horvatić 1963  
Cymbopogono-Brachypodion ramosi Horvatić 1963  
Stipo australis-Hyparrhenietum hirtae Biondi et Guerra 2008

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Table 1 - *Lysimachio foeminae-Atractylidetum cancel- latae*. Rels 1–4: Loc. S. Arcangelo road towards Senise 24/07/2001; rels 5–7: Madonna delle Grazie (Pisticci) 28/04/2001; rel. 8: Calanchi di Aliano 18/05/2001; rels 9–16: loc. Cozzica (Matera - Basilicata) 25/05/2002.

Table 2 - *Campanulo erini-Micromerietum microphy- lae*. Rels 1–14: surroundings of Masseria Accetta Grande (a site located between the city of Taranto and the towns of Statte and Massafratra) 18/05/2008.

Table 3 - *Stipo-Hyparrhenietum hirtae*. Rels 1–5: Gravina di Laterza. Site of Villa Ceglie and surrounding areas 18/05/2008 (Laterza - Puglia).

Table 4 - *Medicago disciformis-Brachypodietum di- stachyi*. Rels 1–2: Gravina di Laterza 19/05/2001; rels 3–6: Calcarenite quarries between Laterza and Matera 03/05/2002.

Table 5 - *Petrosedum ochroleucum* subsp. *mediterraneum* community. Rels 1–5: Calcarenite quarries between Laterza and Matera 03/05/2002.