

## Syntaxonomic revision of the *Arrhenatherum elatius* grasslands of central Italy.

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### Abstract

A phytosociological study of the *Arrhenatherum elatius* grasslands of central Italy is here presented. These vegetation types can be found from sub-coastal to montane areas, and they have an ecology that has aspects that are mesophilous to mesohygrophilous. These grasslands are characterised by high species diversity and they have been maintained by human activities like mowing and fertilising, and sometimes irrigation. An examination of the various aspects of these grasslands that have already been described in Italy was carried out, and a phytosociological table of 45 relevés was constructed, 16 of which were unpublished, and 29 of which come from already published phytosociological tables. The analysis of this table leads to our proposal of the new alliance *Ranunculo neapolitani-Arrhenatherion elatioris*, for which the new association *Ranunculo neapolitani-Arrhenatherum elatioris* is indicated as the type association. This new alliance brings together all of the *Arrhenatherum elatius* grasslands in central Italy, from the upper mesotemperate to the lower supratemperate bioclimatic belts, with penetration into the mesomediterranean bioclimatic belts, although only under compensatory edaphic conditions. The proposed alliance is the central Italian vicariant of the central European alliance of *Arrhenatherion elatioris* Koch 1926.

Key words: mowed grasslands, phytosociology, *Arrhenatherion elatioris*, *Ranunculo neapolitani-Arrhenatherion elatioris*, central Italy

### Riassunto

Viene presentato o studio fitosociologico delle praterie ad *Arrhenatherum elatius* presenti in Italia centrale. Si tratta di tipologie vegetazionali rinvenibili dai settori sub-costieri a quelli montani, ed hanno una ecologia che comprende aspetti da mesofili a mesoigrofilo. Sono praterie caratterizzate da un'elevata diversità specifica e mantenute dalle attività antropiche di sfalcio, la concimazione e, talora, d'irrigazione. Viene fatta una disamina dei diversi aspetti di tali praterie già descritte per l'Italia e costituita una tabella fitosociologica di 45 rilievi di cui 16 inediti e 29 provenienti da tabelle fitosociologiche già pubblicate. L'elaborazione di questa porta a proporre la nuova alleanza *Ranunculo neapolitani-Arrhenatherion elatioris* della quale l'associazione *Ranunculo neapolitani-Arrhenatherum elatioris* ass. nova viene indicata come associazione tipo della stessa. La nuova alleanza riunisce le praterie ad *Arrhenatherum elatius* presenti nell'Italia centrale, dal piano bioclimatico mesotemperato superiore a quello supratemperato inferiore, con penetrazioni in quello mesomediterraneo ma solo in condizioni di compensazione edafica. L'alleanza proposta rappresenta la vicariante nell'Italia centrale dell'alleanza centro-europea *Arrhenatherion elatioris* Koch 1926.

Parole chiave: prati falciabili, fitosociologia, *Arrhenatherion elatioris*, *Ranunculo neapolitani-Arrhenatherion elatioris*, Italia centrale.

### Introduction

The mowed grasslands of *Arrhenatherum elatius* (L.) J. & C. Presl can be found from subcoastal to montane areas, and they are mesophilous and mesohygrophilous communities. They are characterised by high species diversity; and they have been maintained by human activities, such as mowing and fertilizing, and sometimes irrigation. These grasslands are now in serious danger of extinction over much of Europe, and especially in Mediterranean and sub-Mediterranean areas. This has arisen because of the collapse of cattle breeding, which has occurred more rapidly in central Italy than in other places, and which has been accompanied by the abandoning of the human activities that led to the creation and maintenance of these grasslands over the centuries. The 92/433/EEC Directive protects these grassland environments as habitat 6510 "Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*)", although they have not been considered a priority, as is now necessary for the reasons already mentioned (Biondi, 2011 *in press*). The choice of the two

indicator species for the Italian situation of the habitat is substantially misleading, and for this reason many regions have ruled out the presence of this habitat in their territory. It has however been reconsidered after the online publication of the interpretation manual of the habitats in Italy, which has allowed many interpretational doubts to be clarified (Biondi & Blasi, 2009).

With this contribution, we want to clarify the syntaxonomical value of these *Arrhenatherum elatius* grasslands of the central sector of the Italian peninsula, and to evaluate their conservation status, so as to provide suggestions for the prevention of their disappearance.

### The grasslands of *Arrhenatherum elatius* in Italy

There is relatively little phytosociological data published for the *Arrhenatherum elatius* grasslands in Italy. This is mainly due to the abandoning of the traditional cultivation practices that has resulted in a large loss of these grasslands. This is much more

evident in the southern areas than in the Alpine and pre-Alpine areas, where this abandoning of the traditional cultivation practices is also currently ongoing, although less dramatically.

The data for northern Italy mainly refer to the south-eastern Alpine and pre-Alpine sectors: Agostini, 1988 (Valsugana); Biondi *et al.*, 2008 (Villa Vigoni – Como Lake); Buffa *et al.*, 1989; 1995 (Valsugana and the Veneto pre-Alpine areas); Mondino, 1964 (Cozie Alps); Oberdorfer, 1964 (Insubria); Pedrotti, 1964 (Sun Valley, in Trentino); Poldini, 1980, 1989, Poldini & Oriolo, 1995 (Friuli Venezia Giulia); Tasinazzo, 2001, 2009 (eastern Veneto plains); and Ubaldi *et al.*, 1990 (the River Baganza basin, in Parma). The few contributions to the Italian peninsula and islands are the following: Allegrezza, 2003 (Marche Apennines); Biondi & Allegrezza, 1996 (hilly areas of Ancona); Pedrotti, 1963 (Valnerina, in Umbria); Venanzoni, 1992 (the River Velino basin, in Rieti); and Raimondo, 1980 (Madonie, in Sicilia).

For the alliance *Arrhenatherion elatioris* Koch, 1926, to which these grasslands are referred, the association *Centaureo carniolicae-Arrhenatheretum elatioris* Oberdorfer 1964 corr. Poldini & Oriolo 1995 is the one that covers the greatest territory in the eastern-central Alpine and pre-Alpine sector (Fig. 1). For central Italy, the following taxa are currently considered: *Pastinaco urentis-Arrhenatheretum elatioris* Biondi & Allegrezza 1996 for the sublittoral hilly areas of Ancona (Biondi & Allegrezza, 1996), *Festuco circummediterraneae-Arrhenatheretum elatioris* for the Marche ridge of Mount San Vicino (Allegrezza, 2003), *Arrhenatheretum* for the river Nera Valley in Umbria (Pedrotti, 1963), and the groupings of *Arrhenatherum elatius* of the River Velino basin (RI) (Venanzoni 1992). For Sicily, there is the association *Urtico-Arrhenatheretum elatioris* (Raimondo, 1980) in the territory of Madonie.

In recent years, important scientific phytosociological (Poldini & Oriolo, 1995) and chorological (Buffa *et al.*, 1997) contributions have allowed the identification of some degree of autonomy of the south-eastern Alpine and pre-Alpine grasslands of *Arrhenatherum elatius*, compared to the analogous coenoses of central Europe. More generally, the results of the chorological analysis of these grasslands of the alliance *Arrhenatherion elatioris* in Europe (Buffa *et al.*, 1997) have lead us to hypothesise the vicariant syntaxa at the European level of the only alliance that is currently recognised: *Arrhenatherion elatioris* Koch 1926.

## Materials and methods

The bioclimatic classification based on the temperature and precipitation data of the



Fig. 1 - Present distribution for the Italian peninsula of the associations included in the alliance *Arrhenatherion elatioris* Koch 1926: *Centaureo carniolicae-Arrhenatheretum elatioris* Oberdorfer 1964 corr. Poldini & Oriolo 1995 (full circle); *Anthoxantho odorati-Brometum erecti* Poldini 1980 (circle); *Pastinaco urentis-Arrhenatheretum elatioris* Biondi & Allegrezza 1996 (square); *Festuco circummediterraneae-Arrhenatheretum elatioris* Allegrezza 2003 (triangle); *Arrhenatheretum* (Pedrotti, 1963) (rhomb), *Urtico-Arrhenatheretum elatioris* Raimondo 1980 (full triangle); taxa don't typified: Aggr. a *Arrhenatherum elatius* in Mondino, 1980 (cross shaped), *Salvio-Dactyletum* Ubaldi, Zanotti & Corticelli, 1990 subass. *arrhenatheretosum* in Ubaldi, Zanotti & Corticelli, 1990 (arrow); Aggr. a *Arrhenatherum elatius* in Venanzoni, 1992 (asterisk).

thermopluviometric stations considered was carried out according to Rivas-Martinez *et al.* (2001). The analysis of the vegetation was carried out according to the phytosociological method of the Zurich-Montpellier Sigmatis School, updated on the basis of the latest acquisitions. This study included 45 relevés, 16 of which were unpublished, and 29 of which come from already published phytosociological tables, the origins of which are given in Table 1.

For the determination of the species and for their chorological and biological characterisation, the following publications were used: The Flora of Italy (Pignatti, 1982), The European Flora (Tutin *et al.*, 1964-1980), Med-Checklist (Greuter, Burdet & Long, 1994) and the Checklist of the Italian Vascular Flora (Conti *et al.*, 2005). The following were also consulted: The Iberian Flora (Castroviejo *et al.* 1986),

SINTAXA	ORIGINAL RELEVÉ	ECOLOGICAL CONTEXT	SUBSTRATE	MACRO, BIOCLIMATE AND VARIANT	THERMOTYPE
<i>Arrhenatheretum</i> Auct.?	Tab. 1: relevés 1-12 in Pedrotti, 1963	River Nera Basin	alluvial	Temperate oceanic (submedit.)	low supratemperate
Aggr. a <i>Arrhenatherum elatius</i>	Tab. 4: relevés 29, 30 e 31 in Venanzoni, 1992	River Velino Basin	alluvial	Temperate oceanic (submedit.)	low supratemperate
<i>Festuco circummediterraneae-Arrhenatheretum elatioris</i> Allegrezza 2003	Tab. 46: relevés 1-7 in Allegrezza, 2003	San Vicino chain marchean Apennine	calcareous	Temperate oceanic	low supratemperate
<i>Pastinaco urentis-Arrhenatheretum elatioris</i> Biondi & Allegrezza 1996	Tab. 4: relevés 1-7 in Biondi & Allegrezza, 96	Subcoastal hills near Ancona	pelitic-arenaceous	Mediterranean	mesomediterranean

Tab. 1 – Phytosociological relevé sources already published used in this study.

The Flora of Greece (Strid & Tan, 2002), The Atlas of Vascular Plants of North Europe (Hulten & Fries, 1986), The Chorological Atlas of the Flora of Central Europe (Meusel, Jager & Weinert, 1965), and The Chorological Atlas of the Vascular Plants of Friuli (Poldini, 2002).

For the grouping of the chorological types, Buffa *et al.* (1997) was followed: Boreal (Circumbor., Eurosib.; Art.-alp.; N-Europ., NE-Europ.), Eurasian (Euras.; Paleotemp.; S-Europ.-S-Siber); European (Europ. (C-S-CN-CE-CS); Europ.-Caucas.), Atlantic (Atl.; Sub-Atl.; W and NW Europ., Medit-Atl.), Orophyte (Orop.-Europ., Orop. S-Europ.; Orop.-SE Europ.; Orop.-SW Europ.; Medit.-Mont.), Oriental (Pontic; Medit-Pontic; Illyrian, SE-Europ.; E-Europ.; SE-Europ.-S Siber.), Mediterranean (Eurimedit.; Stenomedit.; Medit.; Medit.-Tur.), Endemic (Endem.), Cosmopolitan (Cosmop., Subcosmop.), Exotic (Adventitious, sp. cultivated).

For the phytosociological nomenclature of the higher syntaxonomic levels, the following were consulted: Ellmauer & Mucina (1993), Oberdorfer (1994) and Rivas-Martinez *et al.* (2001).

Classification of the relevés was carried out using the ARCVeG2 multivariate analysis programme (Burba *et al.*, 1992). The methods used are those of the average linkage model (Anderberg, 1972) for the matrices of similarity between surveys.

### Environmental characteristics of the study area

The study area included several zones of Umbria and Marche (central Italy) with bioclimatic characteristics that ranged from the mediterranean macroclimate, mesomediterranean bioclimatic belt, to the temperate macroclimate, upper mesotemperate and lower supratemperate bioclimatic belts (Table 2). The substrates were of various types: pelitic, pelitico-

arenaceous, calcareous and alluvial. The ecological environment mainly included the sublittoral hills of the Province of Ancona, the calcareous ridges of the Umbria-Marche Apennines, the infra-Apennine alluvial basins, and the pre-Appennine hilly heights of Umbria (Fig. 2).

The *Arrhenatherum elatius* grasslands in these areas are very rare, and they are currently managed by annual mowing, which is often accompanied by fertilisation. The abandoning of cultivation practices due to the decline of the pastoral activities has seriously endangered these phytocoenoses, which were already rare, and has encouraged the growth of shrubs in the more mesophilous formations, and the drying up of the formations on the drier soils, with the consequent changes in the floristic cortège of the communities. In some parts, the reduction in the areas covered by these grasslands is linked to a drastic change in the management of the territory through the cultivation of cereals and alfalfa, or to infrastructural and urban transformations.

### Results and discussion

The dendrogram obtained from the classification of the 45 phytosociological relevés shows two main clusters (Fig. 3): the first, and most consistent, is divided into three subclusters. The first cluster (Cluster I) includes the relevés from Umbria and from the internal sectors of Marche, with a temperate oceanic bioclimate, from the upper mesotemperate to the lower supratemperate bioclimatic belt. The second cluster (Cluster II) brings together the relevés published for the sublittoral hilly areas of Ancona (Biondi & Allegrezza, 1996), with a mediterranean macroclimate, mesomediterranean bioclimatic belt, on pelitic and pelitico-arenaceous substrata, included in the association *Pastinaco urentis-Arrhenatheretum*

Meteorological station (altitudinal meter)	Years obs.	Pi	Ti	mi	Mi	m	M	MACROCLIMATE AND VARIANT	BIOCIMATE	BIOCIMATE BELT
Ancona (17)	23	789	14,9	12,0	17,5	2,5	7,5	Mediterranean	Pluviseasonal-oceanic	Upper mesomediterranean low subhumid
Carpegna (748)	11	1145	10,9	12	15,0	-0,7	4,7	Temperate	oceanic	Low supraterperate low humid
Camerino (664)	46	1062	12,2	8,8	15,6	0,7	5,1	Temperate var. submedit.	oceanic	Upper mesotemperate low humid
Fabriano (357)	24	841,1	13,4	7,7	19,1	-3,3	5,3	Temperate var. submedit.	oceanic	Upper mesotemperate low humid
Norcia (604)	38	861	11,6	5,4	17,9	-2,9	6,0	Temperate var. submedit.	oceanic	Low supraterperate low humid
Osimo (100)	21	749	13,4	8,2	18,6	1,2	8,7	Temperate var. submedit.	oceanic	Low mesotemperate low humid
Sansepolcro (330)	32	941	13,3	8,5	18,0	0,6	7,6	Temperate var. submedit.	oceanic	Upper mesotemperate upper subhumid
Spoletto (396)	16	1119	12,8	7,1	18,4	-0,5	7,5	Temperate var. submedit.	oceanic	Upper mesotemperate low humid
Urbino (451)	46	864	12,5	9,0	15,8	0,5	6,0	Temperate var. submedit.	oceanic	Upper mesotemperate low humid

Tab. 2 - Climate data and bioclimate classification of the thermopluviometric stations considered.

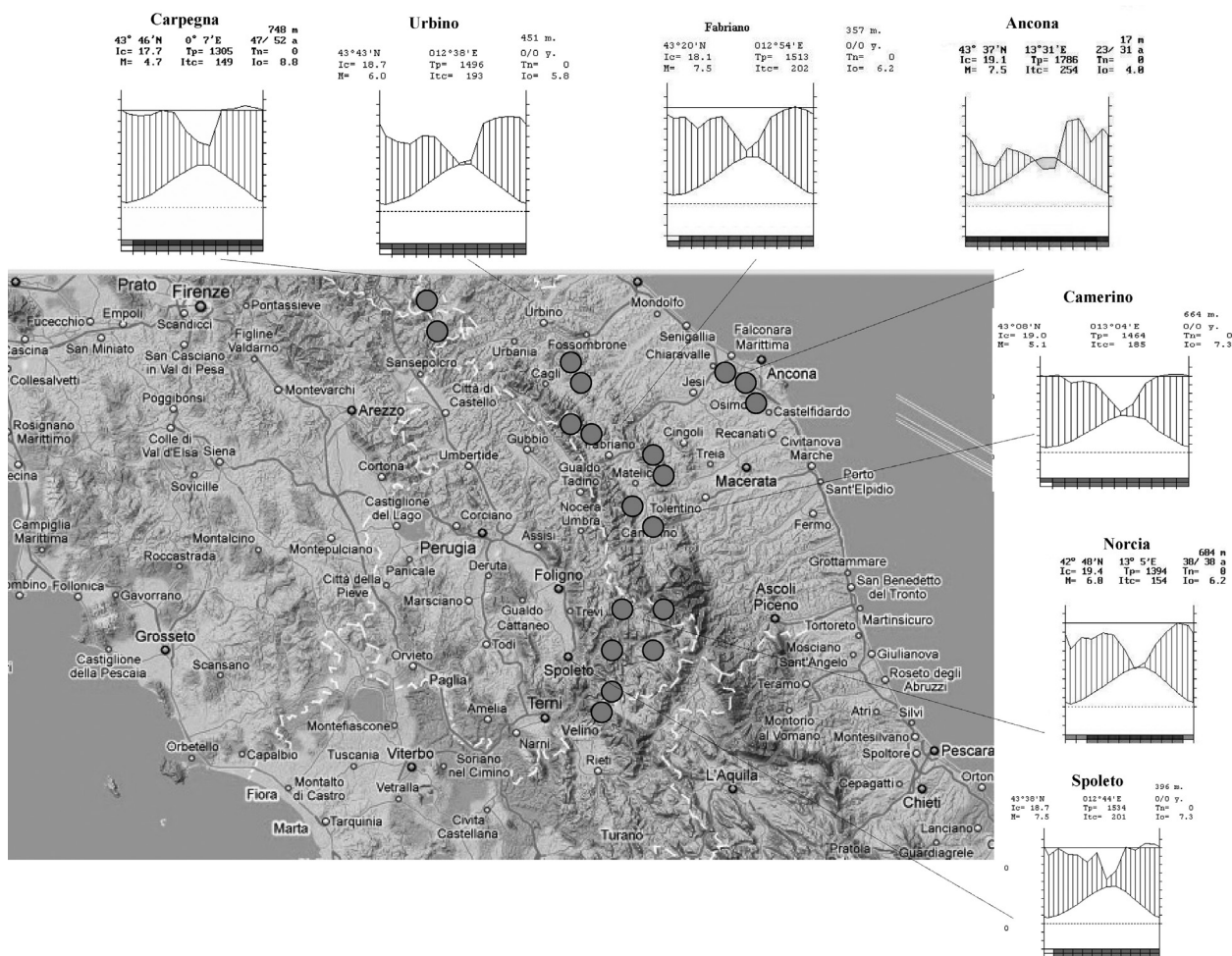


Fig. 2 - Geographic location of the surveys considered in the present study.

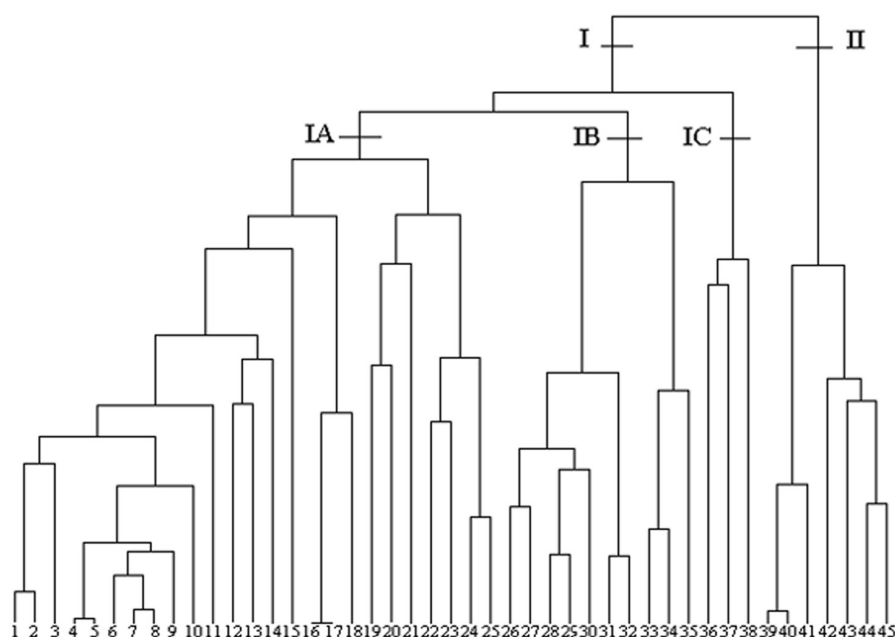


Fig. 3 - Dendrogram of the classification of the 45 phytosociological relevés considered.

*elatioris*.

Within the first cluster, subcluster IA brings together the relevés that mainly come from alluvial deposits, which are sometimes marshy, of the basins of the Nera, Velino and Potenza Rivers, on soils with a high clay component and often affected by prolonged water stagnation. In addition to a series of unpublished relevés, this subcluster includes relevés published by Pedrotti (1963) and Venanzoni (1992).

The second subcluster (subcluster IB) includes the relevés from the lower supratermperate bioclimatic belt of the Marche calcareous ridges, some of which have already been published and included in the association *Festuco circummediterraneae-Arrhenatheretum elatioris* (Allegrezza, 2003).

There is also subcluster IC, which includes the relevés from the lower supratermperate bioclimatic belt of Mount Strega of the Umbria-Marche calcareous ridges, on soils with a high skeleton content.

The synoptical table realised (Table 3) shows the three main groups of the relevés highlighted in the dendrogram. The first column includes the most mesophilous aspects of these grasslands, for which we propose the new association *Ranunculo neapolitani-Arrhenatheretum elatioris* (Table 4). The second column includes the relevés of these submontane and calcareous grasslands of the Marche and Umbria-Marche calcareous ridges, of the association *Festuco circummediterraneae-Arrhenatheretum elatioris* (Table 5). Finally, the third column includes the relevés of the Mediterranean and sub-Mediterranean sectors of Ancona Province, included in the association *Pastinaco-Arrhenatheretum elatioris* (Table 6).

The actual biological spectra for the three columns (Fig. 4) shows their high levels of hemicryptophytes,

followed by therophytes and geophytes, while other biological categories are poorly represented.

The chorological spectra of the three columns (Fig. 5) show that the prevalent Eurasian group is followed by the Mediterranean species with the highest levels in the association *Pastinaco urentis-Arrhenatheretum elatioris* (Buffa *et al.*, 1997).

On the basis of the data obtained, we propose the new alliance *Ranunculo neapolitani-Arrhenatherion elatioris*, for which the new association *Ranunculo neapolitani-Arrhenatheretum elatioris* is indicated as the type association.

The new alliance brings together the *Arrhenatherum elatius* grasslands in central Italy, from the upper mesotemperate to the lower supratermperate bioclimatic belts, with penetration into the mesomediterranean, although only under compensatory edaphic conditions.

The proposed alliance represents the central Italian vicariant of the central European alliance *Arrhenatherion elatioris* Koch 1926. Indeed, in the central European alliance hardly any of the characteristic species of *Arrhenatherion elatioris* can be found, apart from *Galium album* (*G. mollugo* ssp. *erectum*) and *Arrhenatherum elatius*, such as: *Campanula patula*, *Crepis biennis*, *Pastinaca sativa* ssp. *sativa* and *Pimpinella major* (Ellmauer & Mucina, 1993; Oberdorfer, 1994). Moreover, there are none of the species indicated as the differentials for the eastern Alpine and pre-Alpine Arc (Poldini & Oriolo, 1995): *Centaurea carniolica* (= *C. nigrescens* ssp. *nigrescens* = *C. nigrescens* ssp. ? *vochinensis* in Greuter, Burdet and Lang, 2008) and *Achillea roseo-alba*.

The analysis of the synoptical table (Table 3) has allowed the identification of the preferred species of the *Arrhenatherum elatius* grasslands of central

Tab. 3 - Synoptical table of the *Arrhenatherum elatius* communities in central Italy

		dendrogramma groups	IA	IB/IC	II
Diff. species of the <i>Ranunculo neapolitani-Arrhenatheretum elatioris</i> ass. nova					
H caesp	CIRCUMBOR.	Holcus lanatus L.	IV	I	II
H caesp	EUROP.-CAUC.	Cynosurus cristatus L.	III	I	.
H ros	EUROP.-CAUC.	Bellis perennis L.	III	I	.
H ros	EUROP.-CAUC.	Leontodon hispidus L.	III	I	.
H ros	CIRCUMBOR.	Taraxacum officinale Weber (aggregato)	IV	I	.
T scap/ H bienn	SUBMEDIT.-SUBATL.	Crepis vesicaria L. ssp. taraxacifolia (Thuill.) Thell.	III	.	.
H scap	COSMOP.	Cerastium holosteoides Fries ssp. triviale (Link) Moschl	III	.	.
T scap	CIRCUMBOR.	Rhinanthus minor L.	II	.	.
H scap	EURIMEDIT.	Galium mollugo L. ssp. mollugo	III	.	.
Diff. species of the <i>Festuco circummediterraneae-Arrhenatheretum elatioris</i> Allegrezza 2003					
H scap	EUROP.-CAUC.	Galium verum L.	I	IV	.
H scap	EURIMEDIT.	Geranium pyrenaicum Burm. f.	II	III	.
G bulb	W-Europ. (Atl.)	Bunium bulbocastanum L.	I	III	.
H scap	MEDIT.-MONT.	Onobrychis viciifolia Scop.	.	IV	.
H caesp	EURIMEDIT.	Festuca circummediterranea Patzke	.	III	.
T scap	EURIMEDIT.	Trifolium incarnatum L. ssp. molinerii (Balbis) Syme	.	II	.
H caesp	SE-EUROP.	Festuca rupicola Heuffel	.	II	.
H caesp	EURASIAT.	Centaurea scabiosa L.	.	III	.
H scap	W-MEDIT.-MONT.	Knautia purpurea (Vill.) Borbas	.	II	.
H caesp	S-EUROP.-S-SIBER.	Trifolium ochroleucum Hudson	.	II	.
Diff. species of the <i>Pastinaco urentis-Arrhenatheretum elatioris</i> Biondi & Allegrezza 1996					
G rhiz	PALEOTEMP.	Tussilago farfara L.	I	.	V
H caesp	PALEOTEMP.	Festuca arundinacea Schreber	I	.	IV
H scap	EURIMEDIT.	Inula viscosa (L.) Aiton	.	.	V
H scap	EURIMEDIT.	Pulicaria dysenterica (L.) Bernh.	.	.	V
H scap	W-STENOMEDIT.	Hedysarum coronarium L.	.	.	IV
T scap	EURIMEDIT.	Blackstonia perfoliata (L.) Hudson	.	.	IV
H scap	EURASIAT.	Senecio erucifolius L.	.	.	IV
H bienn	PALEOTEMP.	Centaurium erythraea Rafn	.	.	III
H scap	PALEOTEMP.	Epilobium tetragonum L.	.	.	II
G bulb	EURIMEDIT.	Gladiolus italicus Miller	.	.	II
Charact. and diff. species of the <i>Ranunculo neapolitani-Arrhenatherion elatioris</i> all. nova					
H caesp	PALEOTEMP.	Arrhenatherum elatius (L.) Presl	V	V	V
H scap	EURIMEDIT.	Ranunculus neapolitanus Ten.	IV	IV	IV
H scap	ENDEM.	Centaurea nigrescens Willd. ssp. neapolitana (Boiss.) Dostal	IV	II	III
H bienn	SUBCOSMOP.	Pastinaca sativa L. ssp. urens (Req.) Celak	II	II	V
H scap	SE-EUROP.	Achillea collina Becker	II	IV	.
T scap	EURIMEDIT.-TURAN.	Dasyphyrum villosum (L.) Borbas	I	II	.
H scap	ILLIRICA	Heracleum spondylium L. ssp. ternatum (Velen.) Brummitt.	III	.	.
H scap	N-MEDIT.	Ranunculus velutinus Ten.	II	.	.
T scap	ENDEM.	Rhinanthus personatus (Behrend.) Bég	.	V	.
Charact. species of the <i>Arrhenatheretalia</i> ord. and the <i>Molinio-Arrhenatheretea</i> class					
H scap	EURASIAT.	Galium mollugo L. ssp. erectum Syme	II	IV	IV
H caesp	PALEOTEMP.	Dactylis glomerata L.	V	V	V
H scap	EUROSIB.	Trifolium pratense L.	V	V	IV
H ros	EURASIAT.	Plantago lanceolata L.	IV	III	III
H caesp	CIRCUMBOR.	Lolium perenne L.	IV	IV	I
H scap	PALEOTEMP.	Lotus corniculatus L.	IV	III	III
T scap	PALEOTEMP.	Medicago lupulina L.	IV	II	III
H scap	SUBCOSMOP.	Rumex crispus L.	I	I	III
H caesp	EURASIAT.	Poa trivialis L.	V	III	III
H rept	CIRCUMBOR.	Agrostis stolonifera L.	I	I	I
H ros	PALEOTEMP.	Potentilla reptans L.	III	II	IV
H caesp	CIRCUMBOR.	Festuca rubra L. gr.	I	V	V
H scap	EUROSIB.	Tragopogon pratensis L./orientale	II	II	.
H scap	EURIMEDIT.	Salvia pratensis L.	III	II	.
H scap	EUROSIB.	Achillea millefolium L.	I	II	.
H scap	CIRCUMBOR.	Rumex acetosa L.	I	II	.
H scap	PALEOTEMP.	Lathyrus pratensis L.	II	I	.
H rept	PALEOTEMP.	Trifolium repens L.	III	III	.
H scap	EUROSIB.	Leucanthemum vulgare Lam.	IV	II	.
T scap	SUBCOSMOP.	Bromus hordeaceus L.	IV	IV	.
H caesp	CIRCUMBOR.	Poa pratensis L.	III	III	.
H caesp	EURASIAT.	Trisetum flavescens (L.) Beauv.	I	II	.
H bienn	EURIMEDIT.	Linum bienne Miller	I	I	.
T scap	EUROP.-CAUC.	Myosotis arvensis (L.) Hill	I	I	.
H caesp	CIRCUMBOR.	Phleum pratense L.	I	I	.
H scap	CIRCUMBOR.	Prunella vulgaris L.	II	.	III
H caesp	EURASIAT.	Festuca pratensis Hudson	I	.	III

H rept	PALEOTEMP.	Ranunculus repens L.	II	.	.
H scap	EURASIAT.	Thalictrum flavum L.	I	.	.
G rhiz	EUROP.-CAUC.	Carex hirta L.	I	.	.
H scap	EUROSIB.	Lychnis flos cuculi L.	I	.	.
H caesp	EURIMEDIT.	Carex distans L.	I	.	.
T scap	EUROP.-CAUC.	Trifolium dubium Sibth.	.	II	.
Charact. species of the <i>Festuco-Brometea</i> class					
H caesp	PALEOTEMP.	Bromus erectus Hudson	I	II	I
H caesp	SUBATL.	Brachypodium rupestre (Host) R. et S.	I	II	II
Ch suffr	OROF. S-EUROP.	Acinus alpinus (L.) Moench	I	I	II
T scap	PALEOTEMP.	Trifolium campestre Schreber	II	I	III
H caesp	EURASIAT.	Anthoxanthum odoratum L.	IV	III	.
H scap	PALEOTEMP.	Sanguisorba minor Scop.	II	IV	.
H scap	SE-EUROP.	Centaurea bracteata Scop.	I	II	.
Charact. species of the <i>Artemisietea vulgaris</i> class					
H bienn	PALEOTEMP.	Daucus carota L.	V	II	V
G rhiz	PALEOTEMP.	Convolvulus arvensis L.	II	III	II
G rhiz	CIRCUMBOR.	Agropyron repens (L.) Beauv.	II	I	III
T scap	EURASIAT.	Sonchus asper (L.) Hill	I	I	III
H scap	PALEOTEMP.	Hypericum perforatum L.	I	II	I
H scap	EUROSIB.	Picris hieracioides L.	I	II	V
H bienn	CENTRO-EUROP.	Anthemis tinctoria L.	I	II	I
H bienn	EURASIAT.	Melilotus officinalis (L.) Pallas	I	I	II
H scap	PALEOTEMP.	Verbena officinalis L.	I	I	I
H scap	EUROP.-CAUC.	Ranunculus lanuginosus L.	I	I	II
H bienn	PALEOTEMP.	Silene alba (Miller) Krause	III	I	.
H scap	EURASIAT.	Cruciata laevipes Opiz	I	IV	.
H scap	PALEOTEMP.	Silene vulgaris (Moench) Garcke	I	II	.
H scap	EURASIAT.	Linaria vulgaris Miller	.	II	I
Other species					
H scap	EURASIAT.	Medicago sativa L.	III	I	V
P lian	EUROP.-CAUC.	Clematis vitalba L.	I	I	I
T scap	EURIMEDIT.	Avena barbata Potter	I	I	III
T scap	EURASIAT.	Geranium dissectum L.	III	I	I
H scap	PALEOTEMP.	Mentha longifolia (L.) Hudson	II	II	.
T scap	MEDIT.-TURAN.	Vicia sativa L.	I	.	V
NP	EURIMEDIT.	Rubus ulmifolius Schott	I	.	III
G rhiz	CIRCUMBOR.	Equisetum telmateja Ehrh.	II	.	II
Sporadic species			38	29	12

Italy, some of which have particular biogeographic value. Together, these species can be considered as the characteristic and differential species of the new alliance, as compared to the *Arrhenatherum elatius* grasslands of central Europe and of the Alpine and pre-Alpine Arc: *Ranunculus neapolitanus* Ten. (= *Ranunculus bulbosus* L. ssp. *aleae* (Willk.) Rouy & Fouc.), *Centaurea nigrescens* Willd. ssp. *neapolitana* (Boiss.) Dostal, diff. *Achillea collina* Becker ex Reichenb., *Pastinaca sativa* L. ssp. *urens* (Req.) Celak, *Ranunculus velutinus* Ten., *Herachleum spondylium* L. ssp. *ternatum* (Velen.) Brummitt., *Dasyphyrum villosum* (L.) Borbas and *Rhinanthus personatus* (Behrend) Beg.

Currently, these entities are considered in different ways from studies that have sometimes grouped them into taxa that have lost their original biogeographic value. We therefore consider it useful to review these to fully express the significance of the choices we have made. So *Ranunculus neapolitanus* = *R. bulbosus* ssp. *aleae* (Greuter *et al.*; Strid & Tan, 2002; Conti *et al.*, 2005) is a species that is widespread in southern European regions with a Mediterranean influence (Fig. 6), where it prefers a humid and fresh environment. In Italy, this species tends to become rare in the north and in the Alpine sector, as highlighted in the Chorological

Atlas of Friuli-Venezia-Giulia (Poldini, 2002).

*Centaurea nigrescens* is endemic to southern-central Italy and it is the vicariant of the *Arrhenatherum elatius* grasslands of central Italy, with *Centaurea carniolica* in the eastern-central Alpine and pre-Alpine Arc, and in Slovenia and Croatia. *Achillea collina* is a south-eastern European species that is a transgressive from the class *Festuco Brometea*, where it has been replaced by *A. millefolium* only under the most humid conditions. *Pastinaca sativa* ssp. *urens* in the southern-central sector of the peninsula is the vicariant of *Pastinaca sativa sativa* ssp. *sativa* of central Europe. *Ranunculus velutinus* is a Mediterranean species that has gravitated to the east and is a transgressive of the alliance *Ranunculion velutini*. *Herachleum spondylium* ssp. *ternatum* is widespread in the northern-central Apennines and in the Balkans, and is the vicariant of *Herachleum spondylium* ssp. *spondylium* of central Europe and the Alpine sector. *Dasyphyrum villosum* is a Euri-Mediterranean-Turanic species that is rare in northern Italy. Finally, *Rhinanthus personatus* is an endemic species of the central Apennines (Pignatti, 1982), and despite being considered synonymous with *R. minor* in Conti *et al.* (2005), we believe this is the correct species, as according to Tutin *et al.* (1964-1980).

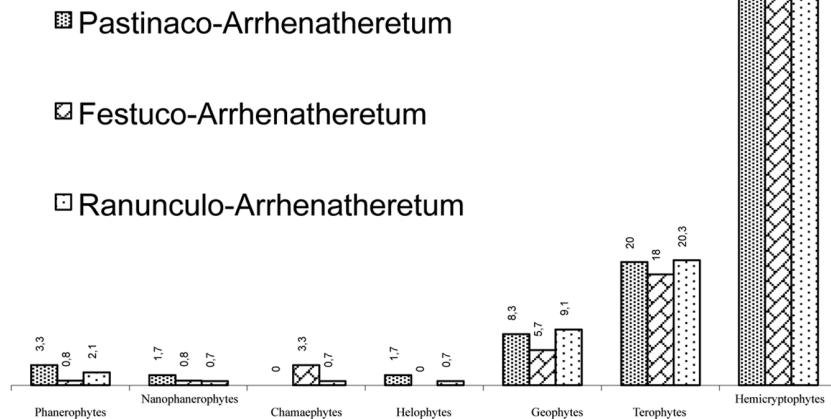


Fig. 4 - Comparison of the actual biological spectra for the three groups considered.

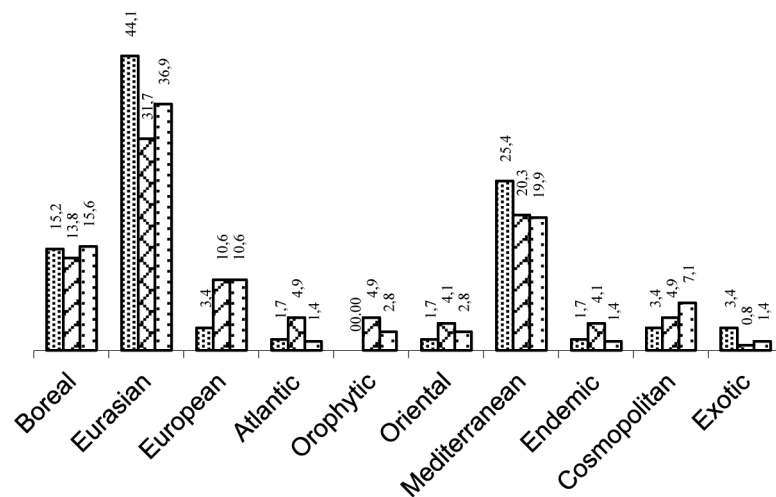


Fig. 5 - Comparison of the actual chorological spectra for the three associations considered.

*RANUNCULO NEAPOLITANI-ARRHENATHERETUM ELATIORIS* ASS. NOVA HOC LOCO (TABLE 4: TYPUS REL. N. 4; CLUSTER AND SUBCLUSTER IA BY FIG. 3)

*ranunculetosum neapolitani* subass. nova subass. typus (rels. 1-15; typus rel. n. 4)

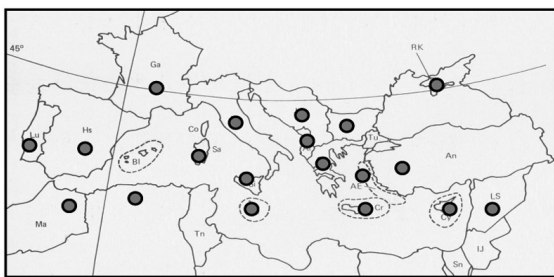
*ranunculetosum velutini*\_subass. nova (rels. 16-18; typus rel. n. 17)

*agropyretosum repentis* subass. nova (rels. 19-25; typus rel. n. 22)

The association *Ranunculo neapolitani-Arrhenatheretum elatioris* is considered the type association of the new alliance, and it includes the *Arrhenatherum elatius* grasslands that are distinctly mesophilous and that can be mainly be found on alluvial deposits. These are sometimes lacustrine, and are frequently subjected to even more prolonged water stagnation. The characteristic and differential species of this new association are (Table 4): *Holcus lanatus*, *Taraxacum officinale*, *Tragopogon pratensis*, *Salvia pratensis*, *Cynosurus cristatus*, *Geranium dissectum*, *Trifolium campestre*, *Heracleum spondylium* ssp. *ternatum*, *Galium mollugo* ssp. *mollugo*, *Colchicum*

*lusitanum*, *Trisetum flavescens* and *Salvia verticillata*. Three subassociations of the association *Ranunculo neapolitani-Arrhenatheretum elatioris* can be identified, which differ according to the lengths of the periods of water stagnation and to the chain contacts that this community has with the associated grassland formations. These subassociations are: *ranunculetosum neapolitani*, *ranunculetosum velutini* and *agropyretosum repentis*. The subassociation *ranunculetosum neapolitani* represents the type association, which has chain contact with the grasslands of the alliance *Cynosurion cristati*. The subassociation *ranunculetosum velutini* is differentiated by *Bellis perennis* and *Ranunculus velutinus*. It is found on land subjected to longer periods of water stagnation, and it is in contact with the coenoses of the alliance *Ranunculion velutini*. Finally, the subassociation *agropyretosum repentis* is differentiated by *Agropyron repens*, *Equisetum telmateja* and *Festuca arundinacea*. It can be found under drier conditions, and it is in chain contact with the grasslands of the alliance *Convolvulo-Agropyron repentis*.

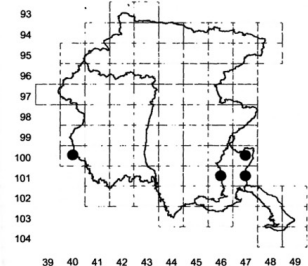




Distribution area of *Ranunculus bulbosus* ssp. *alae* (= *Ranunculus neapolitanus* Ten.) inferred by Med-Ceck list (Greuter Burdet & Long 1989)



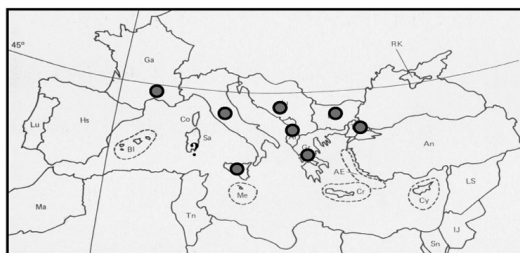
Distribution area of *Ranunculus neapolitanus* Ten. (= *R. bulbosus* ssp. *alae*) inferred by Conti *et al.* (2005)



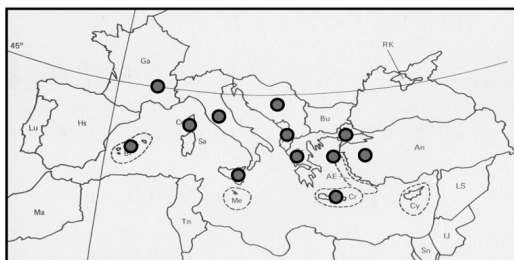
Distribution area of *Ranunculus bulbosus* ssp. *alae* by Poldini (2002)



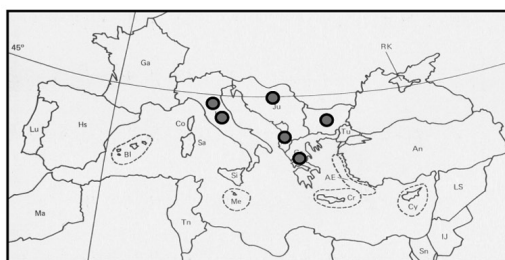
Distribution area of *Centaurea nigrescens* Willd. ssp. *neapolitana* (Boiss.) Dostal inferred by Conti *et al.*, 2005



Distribution area of *Achillea collina* Becker ex Reichenb. inferred Med-Ceck list (Greuter Burdet & Long, 2008)



Distribution area of *Ranunculus velutinus* Ten. Inferred by Med-Ceck list (Greuter Burdet & Long 1989)



Distribution area of *Heracleum spondylium* L. ssp. *ternatum* (Velen.) Brummitt. Inferred by Med-Ceck list (Greuter Burdet & Long 1989)



- ssp. *sativa*
- ssp. *urens* (Req.) Celak

Distribution area of *Pastinaca sativa* L. inferred by Conti *et al.*, 2005; Poldini (2002) doesn't point the ssp. *urens* for the Friuli



Distribution area of *Rhinanthus personatus* (Behrend) Beg. by Pignatti (1982)

Fig. 6 - Distribution of the preferred species of the *Arrhenatherum elatius* grasslands of central Italy that have particular biogeographic value and are differential with respect to the *Arrhenatherum elatius* grasslands of central Europe and of the Alpine and Pre-Alpine Arc.

*FESTUCO CIRCUMMEDITERRANAE-ARRHENATHERETUM ELATORIS* ALLEGREZZA 2003 (TABLE 5: TYPUS REL. N. 1 IN ALLEGREZZA, 2003; CLUSTER AND SUBCLUSTER IB/IC BY FIG. 3)

*festucetosum circummediterranae* subass. nova  
subass. typus (rels. 1-7: typus n. 1);

*trisetetosum flavescens* subass. nova (rels. 8-10; typus rel. n. 9);

*hypericetosum perforati* subass. nova (rels. 11-13; typus rel. n. 11).

The submontane and calcareous *Arrhenatherum elatius* grasslands of the calcareous ridges are mainly spread through the lower supratemperate bioclimatic belt, in areas that have the potential for the submontane beech woods of the association *Lathyro veneti-Fagetum sylvaticae*. They can often be found on man-made terraces, that were built to reduce the slope and to support the establishment of hay meadows. From the phytosociological point of view, they are included in the association *Festuco-Arrhenatheretum elatoris*, which is differentiated by transgressive species of the alliance *Phleo ambigu-Bromion erecti*, and of the class *Festuco Brometea*, with which the *Arrhenatherum elatius* grasslands in these areas are often in chain contact. The characteristic and differential species of the association are considered: *Festuca circummediterranea*, *Galium verum*, *Onobrychis viciifolia*, *Centaurea scabiosa*, *Festuca* gr. *rubra*, *Galium mollugo* ssp. *erectum*, *Trifolium incarnatum* ssp. *molinieri*, *Bunium bulbocastanum*, *Festuca rupicola*, *Dasyphyrum villosum*, *Achillea collina* and *Rhinanthus personatus*. Three subassociations have been identified for this association. *Festucetosum circummediterranae*, as described for the ridge of Mount San Vicino (Allegrezza, 2003), corresponds to the type subassociation, and it has a steppe character that is highlighted by *Festuca rupicola* and *Dasyphyrum villosum*. The new subassociation

*trisetetosum flavescens* refers to the mountain *Arrhenatherum elatius* grasslands, which are cooler and more humid, and differentiated by *Trisetum flavescens*, *Knautia purpurea*, *Trifolium ochroleucum*, *Cynosurus echinatus* and *Achillea millefolium*. Finally, the new subassociation *hypericetosum perforati* is differentiated by *Hypericum perforatum*, *Picris hieracioides*, *Anthemis tinctoria* and *Melilotus officinalis*, and it identifies the post-cultivation formations found on soils that are rich in skeleton and have a more ruderal character.

*PASTINACO URENTIS-ARRHENATHERETUM ELATORIS* BIONDI & ALLEGREZZA 1996

(Table 6: type rel n. 1 in Biondi & Allegrezza, 1996; Cluster II by Fig. 3)

The Mediterranean and sub-Mediterranean *Arrhenatherum elatius* grasslands belong to the association *Pastinaco urentis-Arrhenatheretum elatoris*, as described for the pelitic and pelitico-arenaceous subcoastal hilly sector near the city of Ancona. The association is characterised by a large contingent of species of the sub-Mediterranean alliance *Inulo-Agrophyron repentis* of the class *Artemisietea*, despite species of the order *Arrhenatheretalia* being well represented, which determined its inclusion in the alliance *Arrhenatherion elatoris* (Biondi & Allegrezza, 1996). The presence of the species *Ranunculus neapolitanus*, *Centaurea nigrescens* ssp. *neapolitana* and *Pastinaca sativa* ssp. *urens* now leads us to reconsider this attribution, and to refer the association to the new alliance *Ranunculo neapolitani-Arrhenatherion elatoris*. Due to the industrial and urban transformation of the subcoastal areas in central Italy, these communities that once occupied large territories are now reduced to small areas. As these are no longer managed, they are inevitably destined for extinction.

### Syntaxonomical scheme

*Molinio-Arrhenatheretea* Tüxen 1937

+*Arrhenatheretalia* Tüxen 1931

\**Ranunculo neapolitani-Arrhenatherion elatoris* all. nova

*Ranunculo neapolitani-Arrhenatheretum elatoris* ass. nova

*ranunculetosum neapolitani* subass. nova

(= *Arrhenatheretum* in Pedrotti, 1963; = agr. a *Arrhenatherum elatius* in Venanzoni, 1992)

*ranunculetosum velutini* subass. nova

*agropyretosum repentis* subass. nova

*Festuco circummediterranae-Arrhenatheretum elatoris* Allegrezza 2003

*festucetosum circummediterranae* subass. nova

*trisetetosum flavescens* subass. nova

*hypericetosum perforati* subass. nova

*Pastinaco urentis-Arrhenatheretum elatoris* Biondi & Allegrezza 1996

## Conclusions

The present study has allowed us to expand and deepen the phytosociological knowledge of the *Arrhenatherum elatius* grasslands of central Italy. The analysis of the phytosociological relevés together with the chorological and biogeographical data have allowed us to propose the new alliance *Ranunculo neapolitani-Arrhenatherion elatioris*, the vicariant in central Italy of the central European alliance *Arrhenatherion elatioris*. Within this new alliance, the new association *Ranunculo neapolitani-Arrhenatheretum elatioris* represents the type association, and there is the association *Festuco circummediterraneae-Arrhenatheretum elatioris* for the *Arrhenatherum elatius* grasslands of calcareous ridges, while the association *Pastinaco urentis-Arrhenatheretum elatioris* represents the more Mediterranean and sub-Mediterranean aspects of the subcoastal type.

These phytocoenoses are included in the non-priority habitat 6510 “Lowland hay meadows (*Alopecurus*

*pratensis*, *Sanguisorba officinalis*)”, which has been unjustly overlooked considering the state in which it is found in Italy, and in particular in the Apennines, where it is in serious danger of disappearing. Indeed, this is a habitat that has a strong human influence, and it can be maintained only through mowing and occasional fertilising, as the potential vegetation is represented by forests. The abandoning of these practices has therefore resulted in the development of the serial stages that rapidly lead to the growth of bushes, which is often preceded by other herbaceous groups, such as communities with *Brachypodium rupestre* and with *Agropyron repens*.

The specific knowledge of the ecology of the different communities identified by the present study can also be used for the restoration and recovery of these phytocoenoses in their own ecological context, and will direct management decisions that need to be taken on for the recovery of these habitats within the Natura 2000 network.





Tab. 5 - *Festuco circummediterraneae-Arrhenatheretum elatioris* Allegrezza 2003  
*festucetosum circummediterraneae* subass. nova subass. typus (rels. 1-7: typus rel. n. 1 in Allegrezza, 2003)  
*trisetetosum flavescens* subass. nova (rels. 8-10: typus rel. n. 9)  
*hypericetosum perforati* subass. nova (rels. 11-13: typus rel. n. 11)

Life form Chorotype		Rel. n.	1*	2	3	4	5	6	7	8	9+	10	11++	12	13	P	
		Dendrogram sequency	26	27	28	29	30	31	32	33	34	35	36	37	38		
		Cluster and subclusters	IB	IB	IB	IB	IB	IB	IB	IB	IB	IB	IC	IC	IC	r	
		Altitude in m	960	910	920	940	955	940	950	870	875	850	950	940	760		
		Exposure	-	-	-	O	NO	O	ONO	SW	NW	S	-	-	-	e	
		Slope (°)	-	-	-	5	5	10	10	5	10	2	-	-	-	s	
		Coverage (%)	100	100	100	100	100	100	100	100	100	100	100	100	100		
		Area (m <sup>2</sup> )	40	30	30	30	40	40	30	70	100	80		100	70		
		n. sp. x rel.	36	29	36	31	28	26	32	29	33	29	35	40	30		
Charact. and diff. species of the <i>Festuco circummediterraneae-Arrhenatheretum elatioris</i> ass. and the <i>festucetosum circummediterraneae</i> subass.																	
H scap	EUROP.-CAUC.	<i>Galium verum</i> L. ssp. <i>verum</i>	1.1	2.3	1.1	3.3	2.2	1.2	+	3.3	2.2	2.3	.	.	.	10	
H scap	MEDIT.-MONT.	<i>Onobrychis viciifolia</i> Scop.	.	.	+2	+2	+2	.	+2	1.2	1.2	1.2	+2	+2	+	10	
H caesp	CIRCUMBOR.	<i>Festuca rubra</i> L. gr.	2.2	.	+2	1.2	2.2	1.2	1.2	1.2	2.2	2.2	.	.	.	9	
H scap	EURASIAT.	<i>Galium mollugo</i> L. ssp. <i>erectum</i> Syme	+2	.	+	.	1.1	1.2	+	.	.	.	+2	3.4	+2	8	
G bulb	W-Europ. (Atl.)	<i>Bunium bulbocastanum</i> L.	+	+	+	.	.	.	.	1.1	1.1	2.2	.	.	.	7	
H caesp	EURASIAT.	<i>Centaurea scabiosa</i> L.	+	1.1	1.1	.	.	.	.	.	2.2	.	+2	2.3	.	6	
H caesp	EURIMEDIT.	<i>Festuca circummediterranea</i> Patzke	2.3	.	+2	1.2	3.4	2.3	3.3	.	.	.	.	.	.	6	
T scap	EURIMEDIT.	<i>Trifolium incarnatum</i> L. ssp. <i>molinieri</i> (Balbis) Syme	.	.	.	.	.	1.1	1.2	+2	1.2	2.2	.	.	.	5	
T scap	EURIMEDIT.-TURAN.	<i>Dasypyrum villosum</i> (L.) Borbas	.	+	+2	+2	.	+2	+2	.	.	.	.	.	.	5	
H caesp	SE-EUROP.	<i>Festuca rupicola</i> Heuffel	1.2	1.2	1.2	1.2	1.2	.	.	.	.	.	.	.	.	5	
Diff. species of the <i>trisetetosum flavescens</i> subass.																	
H caesp	EURASIAT.	<i>Trisetum flavescens</i> (L.) Beauv.	.	.	.	.	.	.	.	2.3	2.2	+2	.	.	.	3	
H scap	W-MEDIT.-MONT.	<i>Knautia purpurea</i> (Vill.) Borbas	.	.	.	.	.	.	.	+2	2.2	2.2	.	.	.	3	
H caesp	S-EUROP.-S-SIBER.	<i>Trifolium ochroleucum</i> Hudson	.	.	.	.	.	.	.	1.2	1.2	1.2	.	.	.	3	
H scap	EUROSIB.	<i>Achillea millefolium</i> L.	.	.	.	.	.	.	.	3.3	1.1	2.3	.	.	.	3	
T scap	EURIMEDIT.	<i>Cynosurus echinatus</i> L.	.	.	.	.	.	.	.	+2	2.2	.	1.1	.	.	3	
Diff. species of the <i>hypericetosum perforati</i> subass.																	
H scap	EUROSIB.	<i>Picris hieracioides</i> L.	.	.	.	.	+	.	.	.	.	.	.	1.1	1.1	1.2	4
H scap	PALEOTEMP.	<i>Hypericum perforatum</i> L.	.	.	.	.	.	.	.	.	.	.	.	+	+	+2	3
H bienn	CENTRO-EUROP.	<i>Anthemis tinctoria</i> L.	.	.	.	.	.	.	.	.	.	.	.	1.1	+2	2.3	3
H bienn	EURASIAT.	<i>Melilotus officinalis</i> (L.) Pallas	.	.	.	.	.	.	.	.	.	.	.	+3	+2	.	2
Charact. and diff. species of the <i>Ranunculo neapolitani-Arrhenatherion elatioris</i> all.																	
H caesp	PALEOTEMP.	<i>Arrhenatherum elatius</i> (L.) Presl	5.5	5.5	4.4	4.5	5.5	3.3	3.4	4.5	5.5	5.5	4.4	4.5	4.5	13	
T scap	ENDEM.	<i>Rhinanthus personatus</i> (Behrend.) Bég	+	1.1	1.1	+	+	+	1.2	1.2	1.1	1.2	3.3	+2	.	12	
H scap	EURIMEDIT.	<i>Ranunculus neapolitanus</i> Ten.	1.1	1.1	1.1	+2	2.3	+	1.1	.	+	+	+	.	.	10	
H scap	SE-EUROP.	<i>Achillea collina</i> Becker	2.2	+2	1.1	1.1	1.1	+2	+	.	.	.	.	+2	.	8	
H scap	ENDEM.	<i>Centaurea nigrescens</i> Willd. ssp. <i>neapolitana</i> (Boiss.) Dostal	.	.	.	.	2.2	1.2	1.2	.	.	.	.	.	+2	4	
H bienn	SUBCOSMOP.	<i>Pastinaca sativa</i> L. ssp. <i>urens</i> (Req.) Celak	.	.	.	.	.	.	.	.	.	.	2.3	2.3	3.3	3	
Charact. species of the <i>Arrhenatheretalia</i> ord. and the <i>Molinio-Arrhenatheretea</i> class																	
H caesp	PALEOTEMP.	<i>Dactylis glomerata</i> L.	+2	1.2	1.2	+2	+2	2.2	+	.	2.2	1.2	1.1	1.1	1.2	12	
H scap	EUROSIB.	<i>Trifolium pratense</i> L.	1.2	1.2	3.3	1.2	2.3	+	1.1	2.2	.	2.2	3.4	+2	1.2	12	
H caesp	CIRCUMBOR.	<i>Lolium perenne</i> L.	3.3	2.2	3.3	3.3	3.4	3.3	4.4	3.3	1.2	2.2	.	.	.	10	
T scap	SUBCOSMOP.	<i>Bromus hordeaceus</i> L.	1.2	1.2	1.2	+2	2.3	1.2	2.2	1.1	.	1.2	.	.	.	9	
H caesp	EURASIAT.	<i>Poa trivialis</i> L.	1.2	.	.	+2	.	.	.	3.4	+	2.3	1.1	1.1	.	7	
H ros	EURASIAT.	<i>Plantago lanceolata</i> L.	.	1.2	1.1	+	1.1	.	+	1.1	.	.	1.1	.	.	7	
H scap	PALEOTEMP.	<i>Lotus corniculatus</i> L.	+2	+2	1.2	+	.	.	.	+2	1.2	.	.	1.2	.	7	
H caesp	CIRCUMBOR.	<i>Poa pratensis</i> L.	1.2	2.2	1.2	3.3	2.3	2.2	+2	.	.	.	.	.	.	7	
H rept	PALEOTEMP.	<i>Trifolium repens</i> L.	+2	1.1	2.2	+2	.	.	.	.	.	.	+2	.	1.1	6	
H scap	EURIMEDIT.	<i>Salvia pratensis</i> L.	1.1	+2	1.2	.	.	+	+	.	.	.	.	.	.	5	
H scap	EURASIAT.	<i>Vicia cracca</i> L.	+2	1.1	.	.	+	.	.	.	.	.	+2	+2	.	5	
H scap	EUROSIB.	<i>Tragopogon pratensis</i> L./orientale	.	.	.	+2	1.1	.	.	.	.	.	2.2	+2	.	4	
T scap	PALEOTEMP.	<i>Medicago lupulina</i> L.	.	.	.	.	.	.	.	.	.	+	+2	+2	1.2	4	
H scap	EUROSIB.	<i>Leucanthemum vulgare</i> Lam.	.	+2	1.2	.	.	.	.	.	.	.	1.1	2.3	.	4	
H ros	PALEOTEMP.	<i>Potentilla reptans</i> L.	+	+2	.	.	.	.	.	.	.	.	.	1.1	+2	4	
T scap	EUROP.-CAUC.	<i>Trifolium dubium</i> Sibth.	+2	+2	+2	.	.	.	.	.	.	.	.	.	.	3	
H scap	CIRCUMBOR.	<i>Rumex acetosa</i> L.	.	.	+	.	.	.	.	.	.	.	1.1	.	+	3	
H caesp	EUROP.-CAUC.	<i>Cynosurus cristatus</i> L.	.	.	.	+2	.	.	.	+2	.	.	.	.	.	2	
H bienn	EURIMEDIT.	<i>Linum bienne</i> Miller	.	+	+	.	.	.	.	.	.	.	.	.	.	2	
H caesp	CIRCUMBOR.	<i>Holcus lanatus</i> L.	+2	.	.	.	.	.	.	.	.	.	.	.	.	1	
H scap	PALEOTEMP.	<i>Lathyrus pratensis</i> L.	.	.	.	.	+2	.	.	.	.	.	.	.	.	1	
H ros	EUROP.-CAUC.	<i>Bellis perennis</i> L.	1.1	.	.	.	.	.	.	.	.	.	.	.	.	1	
H ros	EUROP.-CAUC.	<i>Leontodon hispidus</i> L.	.	.	.	.	.	.	.	.	.	.	+2	.	.	1	
H ros	CIRCUMBOR.	<i>Taraxacum officinale</i> Weber (aggregato)	.	.	.	.	.	.	.	.	.	1.2	.	.	.	1	
T scap	EUROP.-CAUC.	<i>Myosotis arvensis</i> (L.) Hill	.	.	+	.	.	.	.	.	.	.	.	.	.	1	
H scap	SUBCOSMOP.	<i>Rumex crispus</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	
H caesp	CIRCUMBOR.	<i>Phleum pratense</i> L.	.	.	.	.	.	.	+2	.	.	.	.	.	.	1	
Charact. species of the <i>Festuco-Brometea</i> class																	
H scap	PALEOTEMP.	<i>Sanguisorba minor</i> Scop.	+	.	+2	+2	.	.	+2	+	1.1	+	+2	.	+	9	
H caesp	EURASIAT.	<i>Anthoxanthum odoratum</i> L.	.	.	+2	1.2	.	2.2	.	1.2	1.1	.	+2	.	.	6	

H caesp	PALEOTEMP.	Bromus erectus Hudson	.	.	.	.	.	.	+2	1.2	1.2	.	.	1.2	.	4	
H scap	SE-EUROP.	Centaurea bracteata Scop.	.	.	+2	1.2	.	.	.	.	.	+	+	.	.	4	
H caesp	SUBATL.	Brachypodium rupestre (Host) R. et S.	.	.	.	.	.	.	.	.	.	+2	+	.	+	3	
Ch suffr	SUBENDEM.	Cerastium arvense L. ssp. suffruticosum (L.) Nyman	+2	+	.	.	1.2	.	.	.	.	.	.	.	.	3	
Charact. species of the <i>Artemisieta vulgaris</i> class																	
H scap	EURASIAT.	Cruciata laevipes Opiz	+	+2	+2	+2	+2	.	+2	.	.	.	.	+2	1.3	.	8
G rhiz	PALEOTEMP.	Convolvulus arvensis L.	+	1.2	+	.	+	.	.	.	.	.	.	.	+	1.2	6
H scap	PALEOTEMP.	Silene vulgaris (Moench) Garcke	+	.	+	.	+2	1.1	+2	.	.	.	.	.	.	.	5
H bienn	PALEOTEMP.	Daucus carota L.	.	.	.	.	.	.	+	+	.	.	.	.	+2	1.1	4
H scap	EURASIAT.	Linaria vulgaris Miller	.	.	.	.	.	.	.	.	.	.	.	+	+	+	3
Other species																	
H scap	EURIMEDIT.	Geranium pyrenaicum Burm. f.	+2	+2	+2	+	1.2	+2	.	.	.	.	.	.	.	.	6
T scap	STENOMEDIT.	Anthemis arvensis L.	.	.	.	.	.	+	+	.	.	.	.	+2	.	.	3
H scap	EUROP.-CAUC.	Geranium sanguineum L.	+	+	.	.	+2	.	.	.	.	.	.	.	.	.	3
H scap	PALEOTEMP.	Mentha longifolia (L.) Hudson	.	.	.	.	.	.	.	.	.	.	.	+	+2	+2	3
Sporadic species																	
			3	1	2	4	1	3	6	7	11	5	7	12	10		

Tab. 6 - *Pastinaco urentis-Arrhenatheretum elatioris* Biondi & Allegrezza 1996

Life form	Chorotype	Rel. n.	Dendrogram sequency							P
			1	2	3	4	5	6	7	
		Dendrogram sequency	39	40	41	42	43	44	45	
		Cluster and subclusters	II	II	II	II	II	II	II	
		Altitude in m	75	75	80	150	170	140	140	
		Exposure	N	SSE	ENE	N	N	N	N	
		Slope (°)	30	35	25	15	10	20	20	
		Coverage (%)	100	100	100	100	100	100	100	
		Area (m <sup>2</sup> )	200	80	30	20	10	30	30	
		n. sp. x rel.	38	30	34	26	24	27	26	
Charact. and diff. species of the ass.										
H scap	EURIMEDIT.	<i>Inula viscosa</i> (L.) Aiton	1.2	2.3	2.3	1.1	1.2	1.1	+	7
G rhiz	PALEOTEMP.	<i>Tussilago farfara</i> L.	1.2	+2	+2	+2	+2	1.2	1.1	7
H scap	EURIMEDIT.	<i>Pulicaria dysenterica</i> (L.) Bernh.	+2	+	+2	4.5	2.3	2.2	2.2	7
H scap	W-STENOMEDIT.	<i>Hedysarum coronarium</i> L.	+	1.2	1.2	+2	.	+2	+	6
T scap	EURIMEDIT.	<i>Blackstonia perfoliata</i> (L.) Hudson	1.1	+	1.1	+	.	1.1	1.1	6
H scap	EURASIAT.	<i>Senecio erucifolius</i> L.	1.1	+	+	.	1.2	.	+2	5
H caesp	PALEOTEMP.	<i>Festuca arundinacea</i> Schreber	1.2	1.2	.	.	1.2	2.3	2.3	5
Charact. and diff. species of the <i>Ranunculo neapolitani-Arrhenatherion elatioris</i> all.										
H caesp	PALEOTEMP.	<i>Arrhenatherum elatius</i> (L.) Presl	2.2	2.2	1.2	1.2	3.4	+2	1.2	7
H bienn	SUBCOSMOP.	<i>Pastinaca sativa</i> L. ssp. <i>urens</i> (Req.) Celak	1.2	1.2	+	1.2	1.2	1.1	1.1	7
H scap	EURIMEDIT.	<i>Ranunculus neapolitanus</i> Ten.	1.1	.	1.1	+	1.1	1.1	.	5
H scap	ENDEM.	<i>Centaurea nigrescens</i> Willd. ssp. <i>neapolitana</i> (Boiss.) Dostal	2.2	2.2	+	+2	.	.	.	4
Charact. species of the <i>Arrhenatheretalia</i> ord. and the <i>Molinio-Arrhenatheretea</i> class										
H caesp	CIRCUMBOR.	<i>Festuca rubra</i> L. gr.	4.4	4.5	4.4	+2	1.2	1.2	1.2	7
H caesp	PALEOTEMP.	<i>Dactylis glomerata</i> L.	2.2	1.2	1.2	1.2	2.3	3.4	3.4	7
H ros	PALEOTEMP.	<i>Potentilla reptans</i> L.	1.2	+	+	1.2	.	+	1.1	6
H scap	EURASIAT.	<i>Galium mollugo</i> L. ssp. <i>erectum</i> Syme	1.2	1.2	.	2.3	+2	2.2	1.2	6
H scap	EUROSIB.	<i>Trifolium pratense</i> L.	+2	+	1.2	.	1.2	1.1	.	5
H ros	EURASIAT.	<i>Plantago lanceolata</i> L.	+	1.1	+	.	.	1.1	.	4
H scap	PALEOTEMP.	<i>Lotus corniculatus</i> L.	1.2	1.2	1.2	.	.	.	.	3
T scap	PALEOTEMP.	<i>Medicago lupulina</i> L.	1.2	1.2	1.1	.	.	.	.	3
H caesp	EURASIAT.	<i>Festuca pratensis</i> Hudson	.	.	.	1.2	.	1.2	+2	3
H scap	CIRCUMBOR.	<i>Prunella vulgaris</i> L.	+	+2	+	.	.	.	.	3
H scap	SUBCOSMOP.	<i>Rumex crispus</i> L.	.	+	+	+	+	.	.	3
H caesp	EURASIAT.	<i>Poa trivialis</i> L.	.	.	+2	.	+2	.	+2	3
H caesp	CIRCUMBOR.	<i>Holcus lanatus</i> L.	1.1	.	.	.	.	.	2.2	2
H caesp	CIRCUMBOR.	<i>Lolium perenne</i> L.	.	.	+2	.	.	.	.	1
Charact. species of the <i>Artemisieta vulgaris</i> class										
H scap	EUROSIB.	<i>Picris hieracioides</i> L.	2.2	2.3	1.1	+	1.1	+	1.1	7
H bienn	PALEOTEMP.	<i>Daucus carota</i> L.	1.1	1.2	1.1	+	1.1	1.1	1.1	7
G rhiz	CIRCUMBOR.	<i>Agropyron repens</i> (L.) Beauv.	.	.	.	+2	+2	.	+	3
T scap	EURASIAT.	<i>Sonchus asper</i> (L.) Hill	+	+	.	.	.	.	+	3
H bienn	PALEOTEMP.	<i>Centaurium erythraea</i> Rafn	.	.	.	+2	+2	.	+	3
H bienn	EURASIAT.	<i>Melilotus officinalis</i> (L.) Pallas	+2	.	+2	.	.	.	.	2
G rhiz	PALEOTEMP.	<i>Convolvulus arvensis</i> L.	.	.	+2	1.1	.	.	.	2
H bienn	CENTRO-EUROP.	<i>Anthemis tinctoria</i> L.	.	.	.	.	+2	.	.	1
H scap	PALEOTEMP.	<i>Hypericum perforatum</i> L.	.	.	.	.	.	+	.	1
T scap	EURASIAT.	<i>Geranium dissectum</i> L.	+	.	.	.	.	.	.	1
P lian	EUROP.-CAUC.	<i>Clematis vitalba</i> L.	.	.	+2	.	.	.	.	1
H scap	EURASIAT.	<i>Linaria vulgaris</i> Miller	+	.	.	.	.	.	.	1
H scap	PALEOTEMP.	<i>Verbena officinalis</i> L.	.	.	.	+2	.	.	.	1
Other species										
H scap	EURASIAT.	<i>Medicago sativa</i> L.	+	+2	2.2	+	1.2	1.2	+	7
T scap	MEDIT.-TURAN.	<i>Vicia sativa</i> L.	1.2	1.1	1.1	1.1	1.1	+	1.1	7
T scap	EURIMEDIT.	<i>Avena barbata</i> Potter	1.1	1.2	2.2	.	.	.	+2	4
T scap	PALEOTEMP.	<i>Trifolium campestre</i> Schreber	+2	+	+	.	.	.	.	3
NP	EURIMEDIT.	<i>Rubus ulmifolius</i> Schott	+	.	.	+2	.	.	+2	3
Sporadic species										
			6	3	5	2	3	5	2	

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## Appendix

Tab. 4 - *Ranunculo neapolitani-Arrhenatheretum elatioris*

## SPORADIC SPECIES

rel. 1: *Vicia pannonica* Crantz ssp. *striata* (Bieb.) Nyman +; rel. 2: *Vicia pannonica* Crantz ssp. *striata* (Bieb.) Nyman +, *Gaudinia fragilis* (L.) Beauv +, *Calystegia sepium* (L.) R.Br. +; rel. 3: *Vicia pannonica* Crantz ssp. *striata* (Bieb.) Nyman +, *Galium verum* L. +, *Plantago major* L. +, *Alopecurus utriculatus* (L.) Pers. +; rel. 4: *Bellevialia romana* (L.) Sweet +, *Thymus serpyllum* L. +, *Veronica arvensis* L. +; rel. 5 - *Ornithogalum umbellatum* L. +, *Thymus serpyllum* L. +; rel. 6: *Onobrychis viciifolia* Scop. +, *Conium maculatum* L. +; rel. 7: *Trifolium resupinatum* L. +, *Alopecurus utriculatus* (L.) Pers. +; rel. 9: *Briza media* L. +; rel. 10: *Veronica arvensis* L. +, *Sherardia arvensis* L. +, *Silene vulgaris* (Moench) Garcke +, *Gaudinia fragilis* (L.) Beauv. +, *Calepina irregularis* (Asso) Thell. +, *Ajuga reptans* L. +; rel. 11: *Galium verum* L. +, *Bromus erectus* Hudson +, *Vicia pannonica* Crantz ssp. *striata* (Bieb.) Nyman +, *Veronica arvensis* L. +; rel. 12: *Veronica arvensis* L. +, *Geranium pyrenaicum* Burm. f. +, *Silene vulgaris* (Moench) Garcke +, *Calepina irregularis* (Asso) Thell. +; rel. 13: *Carex acutiformis* Ehrh. +, *Veronica chamaedrys* L. +, *Vicia sepium* L. +, *Tussilago farfara* L. +; rel. 14: *Cruciata glabra* (L.) Ehrend. +, *Plantago major* L. +, *Sonchus oleraceus* L. +, *Onobrychis viciifolia* Scop. +, *Myosotis scorpioides* L. +, *Veronica chamaedrys* L. +; rel. 15: *Myosotis scorpioides* L. +, *Vicia sepium* L. +, *Rhinanthus alectorolophus* (Scop.) Pollich 1, *Knautia arvensis* (L.) Coulter +, *Viola hirta* L. +, *Anchusa italica* Retz. +; rel. 16: *Vicia sativa* L. +, *Sherardia arvensis* L. +, *Centaurea bracteata* Scop. +, *Cruciata laevipes* Opiz 1.2, *Ornithogalum umbellatum* L. 2.2; rel. 17: *Ornithogalum umbellatum* L. +, *Cruciata laevipes* Opiz 1.2; rel. 18: *Sherardia arvensis* L. +; rel. 19: *Agrimonia eupatoria* L. +, *Centaurea bracteata* Scop. +, *Tordylium apulum* L. +, *Quercus cerris* L. pl. +, *Campanula rapunculus* L. +, *Crepis sancta* 1.1, *Picris echioides* L. +, *Prunus spinosa* L. +; rel. 20: *Agrimonia eupatoria* L. +, *Bromus erectus* Hudson +, *Tordylium apulum* L. +, *Quercus cerris* L. pl. +, *Clematis vitalba* L. +, *Verbena officinalis* L. +, *Odontites lutea* (L.) Clairv. +, *Dianthus monspessulanus* L. +; rel. 21: *Geranium pyrenaicum* Burm. f. +, *Centaurea bracteata* Scop. +, *Galium verum* L. (+), *Tordylium apulum* L. +, *Quercus cerris* L. pl. +, *Clematis vitalba* L. +, *Cirsium morisianum* Rchb. +, *Picris hieracioides* L. +, *Brachypodium rupestre* (Host) R. et S. +, *Scabiosa columbaria* L. +, *Sonchus asper* (L.) Hill +, *Anthemis tinctoria* L. +, *Melilotus officinalis* (L.) Pallas +, *Clinopodium vulgare* L. 1.1, *Galega officinalis* L. (+), *Rubus ulmifolius* Schott +, *Trifolium angustifolium* L. +; rel. 22 : *Carduus pycnocephalus* L. +, *Geranium pyrenaicum* Burm. f. +, *Geranium molle* L. +, *Verbena*

*officinalis* L. +, *Picris hieracioides* L. 1.1, *Pteridium aquilinum* (L.) Kuhn +, *Crepis vesicaria* L. ssp. *vesicaria* +; rel. 23: *Artemisia vulgaris* L. 1.1, *Geranium pyrenaicum* Burm. f. +, *Geranium molle* L. +, *Cirsium morisianum* Rchb. +, *Sonchus oleraceus* L. +, *Vicia sativa* L. 1.1, *Agrostis stolonifera* L. +, *Crepis vesicaria* L. ssp. *vesicaria* +; rel. 24: *Artemisia vulgaris* L. +, *Carduus pycnocephalus* L. 2.2, *Cruciata laevipes* Opiz 1.1, *Geranium molle* L. +, *Veronica chamaedrys* L. +, *Galium aparine* L. +, *Dasypyrum villosum* (L.) Borbas +, *Torilis arvensis* (Hudson) Link +, *Urtica dioica* L. +, *Eupatorium cannabinum* L. (+) ; rel. 25: *Artemisia vulgaris* L. 1.1, *Agrimonia eupatoria* L. +, *Carduus pycnocephalus* L. +, *Cruciata laevipes* Opiz 1.1, *Centaurea bracteata* Scop. +, *Bromus erectus* Hudson (+), *Galium aparine* L. +, *Dasypyrum villosum* (L.) Borbas 1.2, *Torilis arvensis* (Hudson) Link +, *Lamium maculatum* L. +, *Lolium multiflorum* Lam. +, *Vicia villosa* Roth +.

## LOCALITY AND DATE OF THE RELEVÉS:

rels. 1-12: Nera basin (by Tab. 1: rels. 1-12 in Pedrotti, 1963); rels. 13-15: Velino Basin (by Tab. 4 rels. 29, 30 and 31 in Venanzoni, 1992); rels. 16-18: Pian delle Melette Media Val Casana – PG (04/06/2006); rels. 19-21: Pieve Santo Stefano: street for Monte Maggio (12/07/2010); rels. 22-25: Alta Valle of Potenza river between Pioraco and Fiuminata villages (MC), rel. 22: Pioraco (junction for Quadriggiana) (15/06/2009), rel. 23: Spindoli of Fiuminata (16/06/2010), rels. 24, 25: Pioraco (16/06/2010)

Tab. 5 – *Festuco circummediterraneae-Arrhenatheretum elatioris*

## SPORADIC SPECIES

rel. 1: *Vulpia ligustica* (All.) Link 1.2, *Artemisia vulgaris* L. +, *Trifolium campestre* Schreber +; rel. 2 : *Vulpia ligustica* (All.) Link 1.2; rel. 3: *Acinos alpinus* (L.) Moench +, *Melampyrum pratense* L. +; rel. 4: *Scabiosa columbaria* L. 1.1, *Teucrium chamaedrys* L. +, *Erodium cicutarium* (L.) L'Hér. +, *Trifolium rubens* L. +; rel. 5: *Diploaxis tenuifolia* (L.) DC. +; rel. 6: *Papaver rhoeas* L. +, *Urtica dioica* L. +, *Capsella bursa pastoris* (L.) Medicus +; rel. 7: *Papaver rhoeas* L. +, *Muscari atlanticum* Boiss. et Reuter +, *Calamintha nepeta* (L.) Savi +, *Linum strictum* L. ssp. *corymbulosum* (Rchb.) Rouy 1.1, *Carduus nutans* L. +, *Eryngium campestre* L. +; rel. 8: *Briza media* L. +, *Plantago media* L. +, *Eryngium amethystinum* L. +, *Orobancha caryophyllacea* Sm. +, *Campanula rapunculus* L. +, *Centaurea ambigua* Guss. +; rel. 9: *Campanula glomerata* L. +, *Plantago media* L. +, *Eryngium amethystinum* L. 1.1, *Helianthemum nummularium* (L.) Miller ssp. *obscurum* (Celak.) Holub +, *Campanula rapunculus* L. +, *Carlina utzka* Hacq. +, *Allium sphaerocephalon* L. +, *Anacamptis pyramidalis* (L.) L. C. M. Richard +, *Crepis lacera* Ten. +,

*Galium lucidum* All. +2, *Prunella laciniata* (L.) L. +; rel. 10: *Orobanche caryophyllacea* Sm. +, *Geranium dissectum* L. +, *Potentilla hirta* L. +, *Allium vineale* L. +, *Ferulago campestris* (Besser) Grec. +; rel. 11: *Oenanthe pimpinelloides* L. +2, *Acinos alpinus* (L.) Moench +2, *Echium vulgare* L. +2, *Rhinanthus alectorolophus* (Scop.) Pollich +2, *Anthyllis vulneraria* L. +3, *Rosa canina* L. sensu Bouleng. +2; rel. 12: *Scabiosa columbaria* L. 1.2, *Briza media* L. +2, *Oenanthe pimpinelloides* L. +2, *Geranium dissectum* L. +, *Silene alba* (Miller) Krause +2, *Clematis vitalba* L. +, *Odontites lutea* (L.) Clairv. +2, *Verbena officinalis* L. +2, *Lamium maculatum* L. +, *Polygala nicaeensis* Risso +, *Crepis neglecta* L. +, *Linum viscosum* L. 1.1, *Scrophularia canina* L. +; rel. 13: *Silene alba* (Miller) Krause +2, *Clematis vitalba* L. +2, *Odontites lutea* (L.) Clairv. +2, *Echium vulgare* L. +, *Avena barbata* Potter +2, *Medicago sativa* L. +, *Agropyron repens* (L.) Beauv. +2, *Agrostis stolonifera* L. +, *Cichorium intybus* L. +2, *Legousia speculum-veneris* (L.) Chaix +2.

LOCALITY AND DATE OF THE RELEVÉS:

rels. 1-7: Monte della Sporta (Marche Side of the Monte San Vicino) (from Tab. 46 rels. 1-7 in Allegrezza, 2003); rels. 8-10: Public Natural Reserve Gola del Furlo (PU) Marche's Appenines (Biondi & Pinzi unpublished 25/6/2008); rels. 11-

13: Monte Strega (Umbria-Marche Region Appenines); rels. 11-12 Parco dei Daini (20/06/2010);, rel. 13: Montelago 18/06/2009).

Tab. 6 - *Pastinaco urentis-Arrhenatheretum elatioris*

SPORADIC SPECIES

rel. 1: *Equisetum telmateja* Ehrh. 1.1, *Epilobium tetragonum* L. +, *Gladiolus italicus* Miller +, *Cirsium italicum* (Savi) DC. +, *Calystegia sepium* (L.) R.Br. +, *Bellevalia romana* (L.) Sweet +; rel. 2: *Epilobium tetragonum* L. +, *Gladiolus italicus* Miller +, *Melilotus alba* Medicus +; rel. 3: *Bromus gussonei* Parl. +2, *Bromus erectus* Hudson +2, *Agrostis stolonifera* L. +2, *Parietaria diffusa* M. et K. +2, *Anagallis arvensis* L. +; rel. 4 : *Brachypodium rupestre* (Host) R. et S. +, *Lotus tenuis* W. et K. +2 ; rel. 5: *Brachypodium rupestre* (Host) R. et S. +2, *Dipsacus fullonum* L. +, *Vicia tenuissima* (Bieb.) Sch. et Th. +; rel. 6: *Equisetum telmateja* Ehrh. +, *Cirsium italicum* (Savi) DC. +, *Dipsacus fullonum* L. +, *Spartium junceum* L. +2, *Phragmites australis* (Cav.) Trin. +2; rel. 7: *Spartium junceum* L. +2, *Phragmites australis* (Cav.) Trin. 1.1.

LOCALITY AND DATE OF THE RELEVÉS:

rels. 1-7: hilly parts near to the town of Ancona (by Tab. 4 rels. 1-7 in Biondi & Allegrezza, 1996)