Geobotany Studies
Basics, Methods and Case Studies

Fabio Conti
Fabrizio Bartolucci

The Vascular Flora of the National Park of Abruzzo, Lazio and Molise (Central Italy)

An Annotated Checklist

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Part I

Introduction

The vascular flora of the Abruzzo, Lazio and Molise National Park has been the subject of more or less extensive research since the first half of the nineteenth century. The first complete list of flora in the protected area, limited to the Abruzzo region, was published in 1959–1960 by Anzalone and Bazzichelli (1960), followed by an update published by Conti (1995) and also including the regions of Lazio and Molise.

The necessity for an updated list of flora incorporating the latest nomenclatural and floristic novelties (especially during the last decade) led to preparation of this flora.

The list of plants was extrapolated from a geographic database including all data from floristic or vegetational references and herbarium specimens concerning the Park area.

This data storage tool was obtained from the database of Abruzzo vascular flora (Conti et al. 2010), adapted to the study area by the addition of the areas of the Park falling in the regions of Lazio and Molise with related floristic and vegetational data. Analysis of the data entered enabled gaps in the floristic knowledge of the Park, such as little or unexplored areas, to be identified, together with the species records requiring confirmation or further study. On the basis of these deductions, field work for the collection of new floristic data was carried out. Verification of the correct identification of herbarium specimens collected in the past, as well as systematic study of critical genera, was also important.

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Geography, Geomorphology and Geology

The National Park falls within three administrative regions (Abruzzo, Lazio and Molise) and covers an area of 104,000 ha, including the external buffer area (Fig. 1). It is a mountainous area in the central part of the Apennines, characterized by a number of chains running in a predominantly North–West, South–East direction, from the mountains overlooking the Fucino to the NW to the Mainarde mountains to the SE. The Park is bounded to the NE by the chain consisting of Montagna Grande, Monte Godi, Serra Rocca Chiarano and Monte Greco and to the SW by the ridge forming the left orographic side of the Liri valley. The highest peaks are Monte Greco (2,285 m), Monte Petroso (2,249 m), Monte Marsicano (2,245 m) and Monte Meta (2,242 m). The rivers flow into the Adriatic and Tyrrhenian seas and involve a number of different basins: the upper Sangro valley (the heart of the Park), the upper valley of the Giovenco river, the Vallelonga valley, the upper valley of the Melfa river (Val Canneto) which then flows into the Liri river and finally the springs and a short stretch of the upper Volturno river.

The geology of the Park is very diversified and consists exclusively of units of the carbonate Lazio-Abruzzo platform and marginally of post-orogenic complex (Vezzani and Ghisetti 1998; D'Andrea et al. 2003; Praturlon et al. 2003). The western sector of the Park between the Liri and Vallelonga valleys is characterized by the Mesozoic internal carbonate platform succession, while in correspondence with the Monte Longana-Serra Lunga complex there are mainly outcrops of whitish limestone with radiolites (upper Cenomanian—Senonian) and dolomitic limestones (limestone dolomite unit, middle Dogger—early Lias). The Vallelonga valley is characterized by alluvial outcrops of sandy-clayey lacustrine deposits and gravelly-sandy fluvial deposits. To the east of the Vallelonga valley, the ridge of Monte Ara dei Merli—Monte Fontecchia is characterized by limestone and dolomitic limestone facies of the platform. The valley of the Giovenco river—upper part of the Sangro river is mainly characterized by clay and sandstone deposits of Val Roveto flysch (Messinian). Eastward meet platform facies evolving to the terms of the margin of the platform as the ridge of Montagna Grande-Monte Marsicano, mainly formed at the base by dolomitic lithologies in stratigraphic succession with

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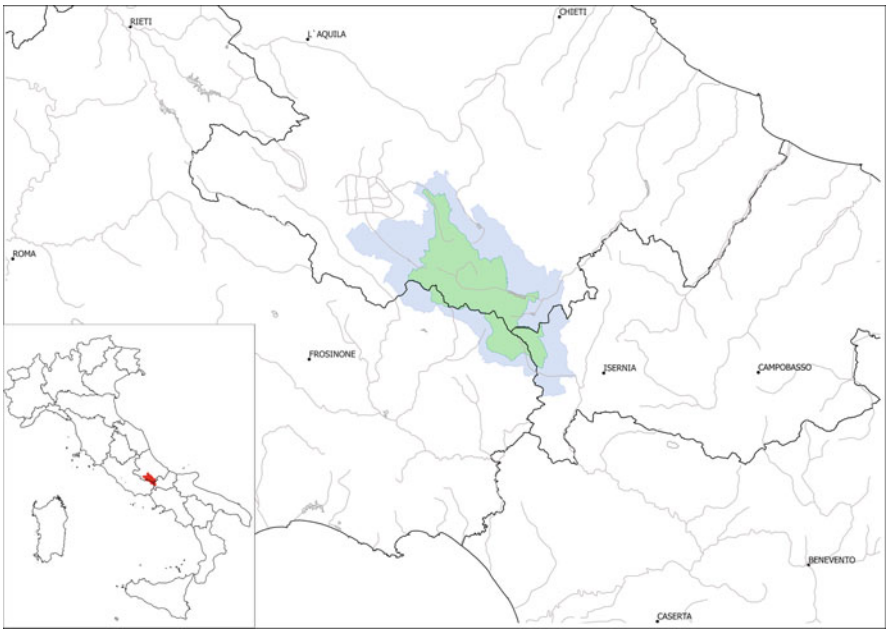

Fig. 1 Map of Abruzzo, Lazio and Molise National Park (green), external buffer area (grey)

palaeodasycladus limestones and in the upper part of the findings from organogenic limestones attributable to the Terratta Formation (Jurassic—Neocomiano). To the east, the Profluo, Tasso and Sagittario valleys are characterized mainly by Anversa degli Abruzzi flysch (Messinian). The Monte Genzana-Monte Greco ridge is characterized by Meso-Cenozoic succession silico-calcareous-marly of basin-slope facies. Finally, in the southern sector of the Park consisting of Monte Meta and the Mainarde mountains there are sequences of carbonate platform and slope facies characterized by calcarenites, detrital limestones and dolomitic limestones.

Climate

Mostly mountainous, the climate parameters of the Park area differ greatly according to altitude. The average annual rainfall ranges from about 650 mm for Anversa degli Abruzzi up to 1,700 mm for some peaks, as shown by the hydrological map (Boni et al. 1986). The maximum values are among the highest in the central Apennines. The data are, however, partial and approximate, lacking meteorological stations at lower altitudes and, from the higher ones, temperature data in particular.

The highest rainfall generally occurs in the autumn with a secondary peak in winter (January) and to a lesser extent in spring (March). The average temperatures are quite low ($\leq$10 °C) and, given the relatively abundant rainfall, do not result in stress from summer aridity, known only for the Barrea station. This stress is, of course, more evident and pronounced in the foothill resort part of the external buffer area with a distinctly Mediterranean climate. No data is, however, available.

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Vegetation Features

The altitude of the National Park of Abruzzo, Lazio and Molise (central Apennines) ranges from 600 to 700 m in the external valleys (Villavallelonga, Alfedena, San Donato Val di Comino, etc.) to the crestline of the mountains, such as Monte Marsicano (2,245 m) and Monte Greco (2,283 m) on the orographic left of the Valle del Sangro and Monte Tranquillo (1,843 m), Monte Capraro (2,100 m) and Monte Meta (2,242 m), on the orographic right.

The Park lies entirely in the eurosiberian region (Conti 2004) with forest vegetation for the most part of deciduous trees of hilly (*Quercus pubescens*, *Q. cerris*, *Ostrya carpinifolia*, *Fraxinus ornus*) and montane zones (*Fagus sylvatica*); the exception is the forests of evergreen sclerophylls (*Quercus ilex*), present in some areas with southern exposure, and those of needle leaves (*Pinus nigra*) of Villetta Barrea, in the Valle del Sangro.

In this altitudinal space, one can recognize the following vegetation belts: hilly (up to 900–1,000 m), montane (from 900–1,000 to 1,800 m), subalpine (from 1,800 to 2,100 m) and alpine (over 2,100 m).

The hilly belt is characterized by deciduous thermophile forests of the *Quercetalia pubescentis* order, with the following associations: flowerish ash (*Melittio melissophylii-Ostryetum carpinfoliae*), scrub oak woods (*Cytiso-Quercetum pubescentis*), turkey oak woods (*Aremonio agrimonioidis-Quercetum cerris* and *Daphno laureolae-Quercetum cerris*).

The flowering ash is limited to the Lazio side of the Park and to a few locations at the entrance of the Vallelonga and the Valle del Sangro, on calcareous substrata; it is always reduced to the state of coppice and interrupted by clearings with secondary meadows of the *Brometalia* order.

The scrub oak woods grow on the slopes of the mountains near the basin of the Fucino, on marly-arenaceous substrata; like the flowering ash woods, they are always reduced to the state of coppice and interrupted by clearings of secondary grazing land of the *Brometalia* order.

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Turkey oak woods are present above all in the middle of the Valle del Sangro, but extensive ones are also found in the high Valle del Sangro, on the right orographic slope.

The landscape of the valley bottom used to be characterized by agriculture fields, but today they are almost completely abandoned, and have been taken over by shrubby vegetation of the *Prunetalia spinosae* order, which forms the classic landscape of closed fields, that is, bordered by hedges or bocage; in some cases the dynamism of the vegetation leads to the formation of woods of trembling poplar of the *Melico uniflorae-Populetum tremulae* association, as at the Gioia Vecchia pass (Pedrotti 1996).

The montane belt is dominated by the great beech forests (Fig. 1), with two associations of the *Fagetalia sylvaticae* order that succeed one another altitudinally, namely *Aremonio agrimonoidis-Fagetum sylvaticae* (900–1,200 m) and *Cardamino kitaibelii-Fagetum sylvaticae* (from 1,200 m to the treeline). The beechwoods for the most part are extensive high forests with continuity throughout the Park, with some large clearings of secondary meadows of the *Brometalia* order (Fig. 2). However, it should be observed that often the belt of beechwoods at the

Fig. 1 Beech forest in Val Cervara (Photo by F. Conti)

Fig. 2 Beech forest with the large clearing of Prato Cardoso (Photo by G. Serafini)

Fig. 3 *Potentilla apennina* and pioneer vegetation in the alpine belt (Photo by F. Conti)

higher altitudes has been eliminated to obtain new grazing areas, today occupied by secondary grazing lands. Most of the beechwoods in the Park are in the dynamic phase of regeneration (Canullo and Pedrotti 1992, 1993).

At the border between the hilly and the montane belts there is a strip of relict pinewoods of black pine (*Pinus nigra*) near Villetta Barrea, on the slopes of the Camosciara.

The subalpine belt, the vegetation of which is very reduced because of grazing, is composed of the Swiss mountain pine wood with the *Polygalo chamaebuxo-Pinetum mugo* and *Orthilio secundae-Pinetum mugo* (Monte Meta) associations, and other shrubby associations spread throughout the mountain massifs of the park, such as: *Helianthemo grandiflori-Juniperetum alpinae* and *Phyteumo orbicularis-Juniperetum alpinae* (Stanisci 1994). The shrubwoods of *Rhamnus alpina* have been attributed to the *Rhamno alpinae-Amelanchieretum ovalis* association, but in part also belong to a new association called *Geranio macrorrhizi-Rhamnetum alpinae* (Conti et Pedrotti, provv.).

The primary meadows of the alpine belt (*Seslerietalia apenninae* order) are spread over the sufficiently high mountains of the park above the treeline and the strip of subalpine shrubs (Bazzichelli and Furnari 1970; Biondi et al. 1992; Di Pietro et al. 2005). The high altitude meadows are important for the Abruzzo chamois (*Rupicapra ornata*), according to the research of Ferrari and Rossi (1985) and Ferrari et al. (1988), which refer in particular to the plant species and types of grazing land preferred by the chamois. In the alpine belt, pioneer vegetation is frequent (Figs. 3, 4, 5 and 6), with a variety of associations such as *Festuco dimorphae-Geranietum macrorrhizi* (Conti and Manzi 1992).

The riverbank vegetation is formed of woods of white willow (*Salicetum albae*) and of black alder (*Aro italici-Alnetum glutinosae*), which are always reduced to a thin, interrupted strip, as along the Sangro River (Pedrotti and Gafta 1996). In the mud along the banks of the artificial lake of Barrea there grows the *Botrydietum granulati* association, formed of algae and liverworts (Aleffi 1992).

Of note for its rarity is the swampy vegetation of *Salicetum apenninae*, present in the Lagozzo, a small lacustrine hollow located in the mountains above Alfedena

Fig. 4 *Mcneillia graminifolia* subsp. *rosanoi* on Mt. Marsicano (Photo by F. Conti)

Fig. 5 Screes on Mt. Marsicano with *Papaver alpinum* subsp. *alpinum* (Photo by F. Conti)

(Spada and Conti 1994; Pedrotti et al. 1996). Another interesting wet environment is Lago Pantaniello, on Monte Greco, which has vegetation of floating and submerged hydrophytes formed of *Potamogeton natans*, *P. lucens* and *P. trichoides* (Naviglio 1984).

In the plain between Opi and Pescasseroli and in a few other locations there are partially flooded wet meadows with the *Hordeo-Ranunculetum velutini* and *Deschampsio-Caricetum distantis* associations (Pedrotti et al. 1992) (Figs. 7 and 8); in the depressed zones of the plain there are also a few strips of *Caricetum elatae*, while in the channels the following associations have been observed: *Nasturtietum officinalis*, *Glycerietum plicatae* and *Gycerio-Sparganietum neglecti*. On the slopes there is also the association of mesophilous meadows of *Cynosuro-Trifolietum repentis* (Fig. 9). The mowing of these meadows is conducted according to very ancient regulations that are still valid today (Manzi 1990).

Finally, of note is the synanthropic vegetation of the areas inhabited by man, composed of many associations including *Conietum maculati*, *Heracleo-Rumicetum obtusifolii*, *Anthriscetum sylvestris*, and *Chaerophylletum aurei*.

Fig. 6 Screes on Mt. Marsicano with *Pedicularis rostratospicata* (Photo by F. Conti)

Fig. 7 Wet meadows with *Euphorbia gasparrini* subsp. *samnitica* in loc. Templo (Photo by F. Conti)

The vegetation of the Park was mapped by Bruno and Bazzichelli (1966, 1968) on a scale of 1:50,000; it includes 18 types of vegetation, corresponding to associations and physiognomic formations; Pignatti (1976) made a map on the scale of 1:25,000 for a sector of the Park that covers Monte Chiarano and surrounding areas.

The Park territory is also included in the maps of all of Italy, such as those by Pedrotti (1991), on a scale of 1:1,000,000 and by Pirone et al. (2010), on a scale of

Fig. 8 Wet meadows in Valle Canale close to Collelongo (Photo by F. Conti)

Fig. 9 Wet meadows and mesophilous meadows with *Cynoglossum apenninum* in loc. Templo (Photo by F. Conti)

1:500,000 and of Europe (Bohn et al. 2000), on a scale of 1:2,500,000; these general maps are useful for understanding on different scales the relationships and contacts between the vegetation of the Park and the surrounding vegetation of the entire central Apennines.

Botanic Exploration

The area of the Abruzzo, Lazio and Molise National Park has been extensively studied, given that the Park has always attracted researchers and promoted new scientific studies. The Park was established in 1923, but the first floristic records date back to the beginning of the 1800s. In a study of the mountains surrounding Scanno, Gravina (1812) was the first to give a list of species present in the Park area. Later Tenore (1831, 1835, 1842) and Tenore and Gussone (1842) published abundant floristic data relating to specific areas such as Monte Meta, the Mainarde mountains, the Chiarano mountains, Monte Greco, Picinisco, Barrea, etc. Some data, mainly for the southern part of the Park such as the Mainarde mountains and Monte Meta, are reported by Terracciano in contributions to the Terra di Lavoro flora (1872, 1873, 1874, 1878, 1890). Falqui (1899) in his "Contribution to the flora of the Liri basin" includes most of Terracciano's reports and covers the area of the Park already studied by Terracciano. An important contribution to the flora of the Park was made by Grande who published a list of plants for the Villavallelonga area (1904) and several floristic notes (Grande 1910, 1913, 1914, 1916, 1924) including many references to the Park area. Also worthy of note are the contributions of Zodda (1931) for the flora of the Mainarde mountains, Vaccari and Wilczek (1940) for the historic sectors of the Park from Gioia dei Marsi to Scanno, the papers of Fiori (1927) and Lusina (1954) and the floristic list deriving from the archived studies of the "Società Botanica Italiana (SBI)" carried out in 1953. These works and the plants collected by Grande provided the basis for the first flora of the Abruzzo National Park by Anzalone and Bazzichelli (1960) listing 1,377 *taxa*. Later, many other botanists studied the Park flora, publishing specific studies, such as on the alpine belt flora (Bazzichelli and Furnari 1970), or individual reports and contributions (Spada 1979; Petriccione 1986, 1988; Conti 1992, 1994; Minutillo 1995). This was followed by publication of a catalogue including 1,912 *taxa* (Conti 1995) and covering a much larger area than that investigated by Anzalone and Bazzichelli (1960), including the successive enlargements of the Park and the external buffer area. The research continued and other findings were published (Orsomando 1975; Scoppola and Modena 1997; Pirone and Tammaro 1997;

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Conti 1998; Conti and Minutillo 1998, 2001; Hennecke and Hennecke 1999; Conti et al. 2002, 2006, 2008, 2011a, b, c; Di Pietro et al. 2004, 2005; Conti and Peruzzi 2006; Peruzzi and Bartolucci 2006; Bartolucci and Peruzzi 2007; Griebl 2010; Conti and Bartolucci 2011a). Also worthy of note is the recent flora of the Sagittario Gorges (Conti and Tinti 2012) which falls partly within the external buffer area of the Park.

Materials and Methods

The following list of flora is based on field surveys carried out from 1999 to 2013 and extensive analysis of relevant literature. The *Herbarium Apenninicum* (APP), Herbarium of the National Park (Pescasseroli) and a few specimens stored in FI, NAP, RO were also consulted to complete the field investigations. The plants collected during our field investigations are stored in the *Herbarium Apenninicum* (APP) at the Apennine Flora Research Center.

The list of flora was extrapolated from the Abruzzo, Lazio and Molise National Park geographic database. The structure of this database was created with File Maker Pro 8.5 software and is relational, with tables relating through identification codes. The tables are:

- the flora of the Abruzzo, Lazio and Molise National Park: giving for each *taxa*, the accepted names, synonyms, endemic, non-native status, conservation status and summary of bibliographic and herbarium data;
- bibliography: reporting for each record in the bibliographic lists, the accepted name of the plant, name used by the author in the publication, synonyms, indicated locality (geo-referenced) and complete bibliographic reference;
- APP Herbarium: reporting for each specimen the accepted name of the plant and complete locality of collection;
- localities: including all the sites mentioned in the records in the bibliographic and APP Herbarium specimens and those derived from the names given in the Istituto Geografico Militare Italiano (IGM) 1:25,000 maps. Each locality is geo-referenced and identified by the corresponding X and Y coordinates (UTM ED50).

The database thus created allows fast comprehensive display and interrogation of a vast amount of data, making them easily manageable for the purpose of proper planning and protection of the area. In addition, the database is designed for integration with a geographic information system (GIS). This allows an area to be defined and a list of *taxa* reported there to be extracted from the database, or

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distribution maps for each species, *taxa* belonging to a specific genus or groups of *taxa* at risk to be generated quickly.

A total of 17,972 records deriving from 252 scientific publications, 9,754 herbarium specimens from the Park area and 2,766 georeferenced localities have been computerized. The field surveys also covered areas bordering on the external buffer area, including the most natural geographical boundaries. Considering this wider area the samples computerized amount to about 12,000.

The systematic order and delimitation of the families follow, for ferns (*Equisetidae*, *Ophioglossidae*, *Polypodiidae*), the classification proposed by Christenhusz et al. (2011a) and for families belonging to the subclasses of the *Magnolidae* and *Pinidae*, Reveal and Chase (2011) and Christenhusz et al. (2011b) respectively. The nomenclature of species and subspecies follows "*An Annotated Checklist of the Italian vascular flora*" (Conti et al. 2005), its integration (Conti et al. 2007) and the update currently underway (Conti et al. in prep.). The status of non-native*taxa* follows the scheme proposed in the recent "Non-Native Flora of Italy" (Celesti-Grapow et al. 2010). We have not listed *taxa* cultivated or introduced for reforestation or ornamental purposes which do not show signs of naturalization.

For each entity, the accepted name, synonyms, preferential environment and frequency of occurrence in the study area (CC = very common; C = common; R = rare; RR = very rare; NC = not confirmed; D = doubtful) are reported.

Others abbreviations or symbols used are as follows:

- New *taxa* for the Park flora: "*"
- Endemic *taxa*: "E"
- Non-native plants: "A" ["NAT" (Naturalized), "INV" (Invasive); "CAS" (Casual)]

Families, genera, species and subspecies are arranged in alphabetical order. *Taxa* of floristic, biogeographical and/or conservation interest are followed by a short note. *Taxa* recorded in literature only and not found during field investigations are indicated in "*italics*".

Part II

Floristic List

A

Adoxaceae

Adoxa moschatellina L. subsp. ***moschatellina*** - *Fagus sylvatica* woods - PC
Sambucus ebulus L. - uncultivated land, ruderal environments - CC
Sambucus nigra L. - humid woods, glades, hedges, ruderal environments - CC
Sambucus racemosa L. - D - Valle di Canneto (Tenore 1835; Tenore and Gussone 1842), Sorgente della Melfa (Lastoria 2000).
Viburnum lantana L. - submontane and montane thermophilous woods and their margins, scrub and hedges, to 1,100 m - C
Viburnum opulus L. - humid woods - R - Scanno (Anzalone and Bazzichelli 1960), Il Lagozzo! (Conti 1994, 1998).
Viburnum tinus L. subsp. ***tinus*** - maquis, woods of thermophilous broadleaves to 800 m - R - Lago di Grotta Campanaro (Spada 1979), Gole del Sagittario! (Conti and Tinti 2012), Monte Falconara!

Alismataceae

****Alisma lanceolatum*** With. - ditches, sluggish or stagnant waters - R - F. Volturno between "l'Abbazia di Castel S. Vincenzo" and the sources!, Lago Vivo!
Alisma plantago - ***aquatica*** L. - ditches, sluggish or stagnant waters - C

Amaranthaceae

A ***Amaranthus albus*** L. - ruderal environments - NAT - Villetta Barrea (Anzalone and Bazzichelli 1960; Viegi et al. 1990 from a specimen collected by Anzalone).

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A

A ***Amaranthus cruentus*** L. (*A. paniculatus* L.; *A. hybridus* L. subsp. *cruentus* (L.) Thell.) - fields -CAS - S. Biagio (Zodda 1931 sub *A. hybridus* L. var. *patulus* (Bert.)).

A ***Amaranthus deflexus*** L. - ruderal environments - NAT - Mainarde (Zodda 1931; Viegi et al. 1990), Val Fondillo (Viegi et al. 1990).

Amaranthus graecizans L. (*A. angustifolius* Lam.) - T - Medit.(Subcosmop.) - fields - uncultivated land - R - Mainarde (Zodda 1931 sub *A. graecizans* L. subsp. *sylvester* (Desf.))

Amaranthus hybridus L. (*A. chlorostachys* Willd.) - uncultivated land - R - Scanno (Viegi et al. 1990).

A ***Amaranthus hypochondriacus*** L. (*A. hybridus* L. var. *erythrostachys* Moq.) - fields of *Zea mays* - CAS - Vallelonga at Molino (Iamonico 2009).

A ***Amaranthus powellii*** S. Watson subsp. ***powellii*** - ruderal environments - NAT - near Barrea (Iamonico et al. 2011).

A ***Amaranthus retroflexus*** L. - ruderal environments - NAT

Atriplex patula L. - T - Eurasiat. - ruderal environments - PC

Blitum bonus-henricus (L.) C. A. Mey. (*Chenopodium bonus-henricus* L.; *Anserina bonus-henricus* (L.) Dumort.; *Agathophyton bonus-henricus* (L.) Moq.; *Orthosporum bonus-henricus* (L.) T. Nees) - H - Eur. - places where animals gather, montane nitrophilous environments - CC

Chenopodiastrum hybridum (L.) S. Fuentes, Uotila and Borsch (*Chenopodium hybridum* L.) - ruderal environments - C

Chenopodiastrum murale (L.) S. Fuentes, Uotila and Borsch (*Chenopodium murale* L.) - walls and ruderal environments - R - Mainarde (Zodda 1931).

Chenopodium album L. subsp. ***album*** - fields and ruderal environments - CC

Chenopodium ficifolium Sm. - ruderal environments - RR - near Civitella Alfedena! (Conti and Iamonico 2013).

Chenopodium opulifolium Schrad. ex W. D. J. Koch & Ziz - ruderal environments - R - near Barrea! (Conti and Minutillo 1998).

Chenopodium vulvaria L. - ruderal environments - C

Lipandra polysperma (L.) S. Fuentes, Uotila & Borsch (*Chenopodium polyspermum* L.; *Vulvaria polysperma* (L.) Bubani) - fields - C

Oxybasis urbica (L.) S. Fuentes, Uotila & Borsch (*Chenopodium urbicum* L.) - ruderal environments - NC - Settefrati near Sora (Terracciano 1872).

Polycnemum arvense L. - uncultivated land, trampled areas - R - Colle dell'Olmo di Bobbi! (Conti and Minutillo 1998), Villavallelonga between the village and Madonna della Lanna in loc. Cona Rovara!

Amaryllidaceae

*E ***Allium calabrum*** (N. Terracc.) Brullo, Pavone & Salmeri - stony slopes - RR - Scatafosse!

Allium coloratum Spreng. (*A. cirrhosum* Vandelli; *A. carinatum* L. subsp. *pulchellum* Bonnier & Layens) - arid and stony slopes - PC