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Bryoflora of the beech-silver fir coenosis of Mount Motola (National Park of Cilento & Vallo di Diano) - Teggiano (Salerno, S-Italy)

Abstract

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The *Fagus sylvatica-Abies alba* coenosis is relict in Southern Italy, and the site on the northern slopes of Mt. Motola represents the most important population of silver fir in Campania. Moreover, this site is included in the area of the National Park Cilento-Vallo di Diano, one of the largest in Italy. This study includes two main aspects, the first considering the ecological and silvicultural features of the area, and the latter the bryological and floristic one. In this paper we report the preliminary findings of the bryological study. Several species, some new for the whole of continental southern Italy, and some new also for central Italy have been reported. The number of species reported is 69, including 7 liverworts (among them *Scapania aspera*, new record for Campania). In particular, we report here three new records for continental southern Italy (*Isopterygiopsis pulchella, Orthotricum pallens, Schistidium rivulare*); two new records for central and southern Italy (*Neckera pumila* var.*pilifera* and *Schistidium apocarpum*), six new records for Campania (*Barbula unguiculata, Bryum subelegans, Dicranum majus, Hypnum andoi, Hypnum resupinatum, Orthotrichum lyellii*). Five species known for Campania from records before 1950 have been found also (*Amblystegium serpens*, *Anomodon viticulosus*, *Plagiomnium affine, Plagiomnium cuspidatum, Zygodon forsteri)*. We report eventually *Zygodon forsteri,* a not common species, known from low altitudes (up to the hills) which we have been found for the first time at higher altitudes. Indicator Values for Mosses and Liverworts have been used to further characterize ecologically the areas studied.

Introduction

The population of silver fir (*Abies alba* Mill.) on the northern slopes of Mount Motola, in the area belonging to the municipality of Teggiano, represents the most important relict association of silver fir in Campania, where it is associated to the beech (*Fagus sylvatica* L.). It is included in the area of the Consortium of communes in the mountain area (Comunità Montana) of Vallo di Diano, and subjected to integral protection (Zone 1) in the national park of Cilento and Vallo di Diano, one of the largest in Italy. It is a Site of Community Interest *(S.C.I.)* and it has been proposed its inclusion in the Nature 2000

Network, a network of Sites of Community Interest containing habitats whose conservation requires the designation of special conservation areas according to the Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora). In this specific case, the site includes a *priority habitat* (according to the Interpretation Manual of European Union habitats, EUR 25), belonging to the group of Mediterranean deciduous forests, and codified with the number 9220: "Apennine beech forests with *Abies alba*".

The Park plan, still not yet in its final form, includes the greatest part of the beech-silver fir coenosis in zone *B1: oriented natural reserve*; other silver firs, in a more marginal position in relation to the main population, might be included in zone *A1: Integral natural reserve* (at the border with the municipality of Sacco), and in zone *B2: Natural reserve oriented to the constitution of older forests,* towards the South. Forest scientists have always attributed a great importance to the *Fagus sylvatica-Abies alba* coenosis, which, in the southern Apennine, has become less and less common in the last centuries. Long-term climatic variations towards the oceanic type might have fostered the beech (Chiarugi 1936). In the case examined, however, as well as in populations nearby the one examined, it appears more likely to be the effect of direct and indirect human impact factors.

The observation of variations in the vegetation features, on the northern slope of the area considered, offers useful indications on the human impact in the past, as it will be showed.

In relation to the bryophytic flora, new investigations are needed as these can contribute to a better understanding of areas already explored in the past (as well as of areas still bryologically unexplored), particularly where habitats of naturalistic value will be presumably subjected, sooner or later, to environmental changes. There are no works, as far as we know, on the bryophytic flora and vegetation of the beech-silver fir coenosis of the southern Apennine. A previous work on the bryophytic flora of Monte Cervati (a nearby area) by Cortini & al. (1993) was carried out in an area where only beech was present. This study has allowed us therefore to further our knowledge of the bryophytic flora of Campania and of the southern Apennine.

Bryophytes have been used several times, and with success, as bioindicators ; in particular, the check-list we have obtained has allowed us to further characterize the ecological and environmental features of the areas under study, by the use of the Indicator Values of mosses and liverworts (Düll 1991). These values, even though originally tuned to areas of Central Europe, appear to be valid also for the areas under study.

The Study Area

The altitudinal belt going from 800 to 900 m a. s. l. is characterized by the presence of *Corylus avellana* L. (hazelnut) in areas previously cultivated. The slopes present a series of terraces, supported by stone-walls, where the erosion due to the flowing of rainwaters, is however still active.

At around 1000 m above sea level sparse and isolated individuals of silver fir are present, mostly in hollows and in areas of difficult access.

The hazelnut stand still maintains the original density of plantation and the stools fea-

ture a high number of shoots, which form a dense and continuous cover not colonized by other species. This area, included in the submontane belt which, up to about the altitude of 800-900 m a.s.l., belongs to the mixed forest of mesophile and mesoxerophile broadleaf trees made up by maples (*Acer campestre* L., *A. obtusatum* W. et K., *A. lobelii* Ten.), ironwood (*Ostrya carpinifolia* Scop.), chestnut (*Castanea sativa* Miller), Italian alder (*Alnus cordata* (Loisel.) Desf.). The stand is of asexual origin, with a multistratified structure, and at some places even impenetrable.

This forest is characterized by a sporadic presence of the silver fir, while in the higher parts of the submontane belt the beech becomes more frequent as compared to other broadleaf trees. In this belt we have recorded the presence of all diametrical classes for silver firs in reproductive age, which were producing cones abundantly, as observed during Fall 2002. These silver firs are here taller than beeches and therefore, their canopy is directly exposed to the sun rays. Their spatial distribution varies from isolated plants, within a stand of beeches, to pure population, with an extension of even a few thousands square meters, characterized by the micro-environmental conditions of the pure silver fir forest.

At higher altitudes (1100-1200 m) the beech becomes the dominant tree and the silver fir almost disappears (old big stumps, and rotting logs, are however visible), while the latter is relatively abundant in the lower belt. These silver firs, about 1-4 m of height, are in a "waiting" phase, and mostly have the vegetative apex damaged by grazing or by contact with branches of the higher trees. For a more detailed study of the silvicultural features of the area refer to Saracino & al. (2004).

The bryophytic flora

In the check–list we have followed for the nomenclature of mosses Cortini Pedrotti (2001a), and for liverworts Schumacker & Váňa (2000). For identifications we have used Cortini Pedrotti (2001b), Casas & al. (2001), Schumacker & Váňa (2000), and Smith (2004). Distribution is based on Cortini Pedrotti (2001a) for mosses, and on Aleffi & Schumacker (1995) for liverworts.

Check-list of the bryophytes of Monte Motola.

LIVERWORTS
Frullaniaceae
Frullania dilatata (L.) Dumort.

Geocalycaceae
Lophocolea bidentata (L.) Dumort.

Lejeuneaceae
Lejeunea cavifolia (Ehrh.) Lindb.

Metzgeriaceae
Metzgeria furcata (L.) Dumort.

Plagiochilaceae
Plagiochila porelloides (Torr. ex Nees) Lindenb.

Radulaceae
Radula complanata (L.) Dumort.

Scapaniaceae
Scapania aspera H.Bernet & M.Bernet [1]

MOSSES
Amblystegiaceae
Amblystegium serpens (Hedw) Bruch & al. [2]
Campylophyllum calcareum (Crundw. & Nyholm) Hedenäs
Cratoneuron filicinum (Hedw) Spruce

Anomododontaceae
Anomodon viticulosus (Hedw.) Hook & Taylor [2]

Bartramiaceae
Plagiopus oederianus (Sw.) H. A. Crum & L.E. Anderson

Brachyteciaceae
Brachythecium rutabulum var. *flavescens* Bruch & al.
Brachythecium velutinum (Hedw.) Bruch & al
Eurhynchium crassinervium (Wils.) Schimp.
Eurhynchium hians (Hedw.) Sande Lac.
Eurhynchium pumilum (Wilson) Schimp.
Eurhynchium speciosum (Brid.) Jur.
Eurhynchium schleicheri (R. Hedw.) Jur.
Eurhynchium striatum (Hedw.) Schimp.
Homalothecium lutescens (Hedw.) H. Rob.
*Homalothecium philippeanum (*Spruce) Bruch & al.
Homalotecium sericeum (Hedw.) Bruch & al
Isothecium alopecuroides (Dubois) Isov.
Rhynchostegium confertum (Dicks) Bruch & al.
Scleropodium touretii (Brid.) L.F. Koch
Scleropodium purum (Hedw.) Limpr.

Bryaceae
Bryum capillare Hedw.
Bryum subelegans Kindb. [1]

Dicranaceae
Dicranum majus Sm. [1]

Distichiaceae
Distichium capillaceum(Hedw.) Bruch & al.

Encalyptaceae
Encalypta streptocarpa Hedw.

Fissidentaceae
Fissidens viridulus(Sw.) Wahlenb.

Grimmiaceae
Grimmia pulvinata (Hedw.) Sm.
Schistidium apocarpum (Hedw.) Bruch. & Schimp. [4]
Schistidium rivulare Brid. [4]

Hypnaceae
Ctenidium molluscum (Hedw.) Mitt.
Hypnum cupressiforme Hedw.
Hypnum andoi A.J.E. Sm. [1]
Hypnum resupinatum Taylor [1]

Leucodontaceae
Antitrichia curtipendula (Hedw.) Schimp.
Leucodon sciuroides (Hedw.) Schwägr.

Mniaceae
Mnium stellare Hedw.

Neckeraceae
Leptodon smithii (Hedw.) Weber & D. Mohr.
Metaneckera menziesii (Drumm.) Steere
Neckera pumila var. *pilifera* Jur. [3]

Orthotrichaceae
Orthotrichum affine Brid.
Orthotrichum lyellii Hook & Taylor [1]
Orthotrichum pallens Bruch ex Brid. [4]
Orthotrichum rupestre Schleich. ex Schwägr.
Orthotrichum speciosum Nees in Sturm.

Orthotrichum striatum Hedw.
Zygodon forsteri (Dicks.) Mitt. [2]
Zygodon rupestris Schimp. ex Lorentz

Plagiomniaceae
Plagiomnium affine (Blandow) T.J. Kop. [2]
Plagiomnium cuspidatum (Hedw.) T.J. Kop. [2]
Plagiomnium undulatum (Hedw.) T.J. Kop.

Plagiotheciaceae
Herzogiella seligeri (Brid.) Z. Iwats.
Isopterygiopsis pulchella (Hedw.) Z. Iwats. [4]

Pottiaceae
Barbula unguiculata Hedw. [1]
Didymodon insulanus (De Not.) M. O. Hill
Pleurochaete squarrosa (Brid.) Lindb.
Syntrichia ruralis ssp. *ruralis* (Hedw.) Web. & D. Mohr
Trichostomum crispulum Bruch
Tortella tortuosa (Hedw.) Limpr.

Pterigynandraceae
Habrodon perpusillus (De Not.) Lindb.
Pterigynandrum filiforme Hedw.

Thamnobryaceae
Thamnobryum alopecurum (Hedw.) Gangulee

Timmiaceae
Timmia austriaca Hedw.

Notes:
1: New record for Campania
2: New records of species reported before 1950 for Campania
3: New record for central and southern Italy
4: New record for continental southern Italy

Characterization of the Station by the Indicator Values of Mosses and Liverworts.

The use of bryophytes as bioindicators for the characterization of environments, also forest ones, has been carried out for a long time. The critical factor is the knowledge of the flora of the area of study and of the ecological characteristics of the single species.

Most of these studies have been carried out in environments of Central Europe (see for example Düll 1991 and references therein). The value of these data for Mediterranean

Table 1. Characterization of the Study Area at 700-900 m a.s.l.
L= Light number; **T**= Temperature number; **C**= Continentality number; **M**= Moisture number; **R**= Reaction number. **X**= taxa not ranked ecologically (ruderal species or species with ample distribution); ***= value not assigned (Düll 1991).

	L	**T**	**C**	**M**	**R**
Anomodon viticulosus	4	3	5	4	8
Barbula unguiculata	7	X	5	2	7
Brachythecium rutabulum var. *flavescens*	5	X	5	4	7
Brachythecium velutinum	5	3	5	4	6
Campylium calcareum	4	5	5	4	8
Cratoneuron filicinum	7	X	5	7	7
Ctenidium molluscum	6	4	5	4	8
Encalypta streptocarpa	5	X	5	5	8
Eurhynchium crassinervium	4	5	6	5	8
Eurhynchium hians	7	4	5	5	7
Eurhynchium pumilum	3	7	4	5	8
Eurhynchium schleicheri	5	5	5	4	8
Eurhynchium speciosum	5	7	5	7	6
Eurhynchium striatum	5	6	3	5	6
Grimmia pulvinata	1	5	5	1	7
Homalothecium lutescens	9	4	5	2	8
Homalothecium philippeanum	5	7	7	4	8
Homalotecium sericeum	8	3	5	2	7
Hypnum cupressiforme	5	X	5	4	4
Isothecium alopecuroides	5	4	6	5	6
Leptodon smithii	8	8	3	4	6
Metaneckera menziesii	4	4	4	7	5
Mnium stellare	4	3	6	5	7
Orthotrichum affine	8	4	5	4	6
Orthotrichum striatum	8	3	4	5	6
Plagiomnium cuspidatum	4	3	4	5	7
Plagiomnium undulatum	4	3	5	6	6
Plagiopus oederianus	4	1	*	6	8
Pleurochaete squarrosa	9	8	5	2	6
Schistidium apocarpum	4	X	5	3	7
Scleropodium purum	6	4	5	4	5
Scleropodium touretii	8	7	4	3	6
Syntrichia ruralis	9	X	5	2	6
Thamnobryum alopecurum	4	4	4	6	7
Timmia austriaca	4	1	6	6	8
Tortella tortuosa	5	X	6	4	8
MEDIAN	**5**	**4**	**5**	**4**	**7**

Table 1. Continued.

	L	T	C	M	R
Anomodon viticulosus	4	3	5	4	8
Antitrichia curtipendula	6	3	4	4	6
Brachythecium rutabulum var. *flavescens*	5	X	5	4	7
Brachythecium velutinum	5	3	5	4	6
Bryum capillare	5	X	5	5	6
Bryum subelegans	5	5	5	5	6
Campylium calcareum	4	5	5	4	8
Dicranum majus	5	3	6	6	3
Distichium capillaceum	4	3	6	5	8
Eurhynchium crassinervium	4	5	6	5	8
Eurhynchium pumilum	3	7	4	5	8
Eurhynchium speciosum	5	7	5	7	6
Fissidens viridulus var. *tenuifolius*	3	4	5	6	9
Habrodon perpusillus	6	8	3	5	5
Herzogiella seligeri	5	4	6	5	4
Homalothecium lutescens	9	4	5	2	8
Hypnum andoi	3	4	3	6	3
Hypnum cupressiforme	5	X	5	4	4
Hypnum resupinatum	6	5	3	5	3
Isopterygiopsis pulchella	4	2	6	6	8
Isothecium alopecuroides	5	4	6	5	6
Isothecium striatulum	3	5	4	4	8
Leucodon sciuroides	8	5	5	4	6
Metaneckera menziesii	4	4	4	7	5
Mnium stellare	4	3	6	5	7
Neckera pumila var. *pilifera*	5	3	4	5	5
Orthotrichum lyellii	7	4	4	4	5
Orthotrichum pallens	4	2	6	4	5
Orthotrichum speciosum	7	2	6	5	5
Orthotrichum striatum	8	3	4	5	6
Plagiomnium cuspidatum	4	3	4	5	7
Plagiopus oederianus	4	1	*	6	8
Pterigynandrum filiforme	6	2	6	5	4
Rhynchostegiella tenella	4	5	4	3	8
Rhynchostegium confertum	4	5	4	5	6
Schistidium rivulare	*	2	6	8	4
Thamnobryum alopecurum	4	4	4	6	7
Zygodon forsteri	6	6	2	6	6
Zygodon rupestris	6	4	5	5	7
MEDIAN	**5**	**4**	**5**	**5**	**6**

environments is to be verified, of course, as they depend on the distribution of the single species and of their ecological characteristics, which may vary at the margin of their areas of distribution. In any case, Mount Motola, presents climatic characteristics of the sub-mediterranean type, in transition towards the oceanic one, like those of areas in Western Central Europe.

Each species is characterized by a series of indices as indicated in Table 1. For each study area a general value is obtained, as indicated by Düll (1991), taking the Median value of each column.

Conclusions

The *Fagus sylvatica-Abies alba* coenosis of Monte Motola, notwithstanding its limited extension, has a bryophytic florula of 69 entities, of which 7 liverworts (*Scapania aspera*, new record for Campania) and 62 mosses. For the mosses, three new records are here reported for the whole continental southern Italy (*Isopterygiopsis pulchella, Orthotricum pallens,* and *Schistidium rivulare*), six new records for Campania (*Barbula unguiculata, Bryum subelegans, Dicranum majus, Hypnum andoi, Hypnum resupinatum,*and *Orthotrichum lyellii*), two new records for Central and Southern Italy (*Neckera pumila* var.*pilifera*, and *Schistidium apocarpum*), and five records of species previously recorded in Campania before 1950 (*Amblystegium serpens*, *Anomodon viticulosus*, *Plagiomnium affine, Plagiomnium cuspidatum,* and *Zygodon forsteri)*. *Zygodon forsteri*, a not common species normally recorded only from plain and hilly areas, is here recorded for the first time from mountain areas.

Moreover, by the use of Düll Indicator Values, a difference for the parameters of soil reaction, and moisture, are clearly detected between the two study areas of Mt. Motola. We have reported in Table 2 the differential species, that is, the species present only in the upper or, alternatively, in the lower par for the two study areas, which, obviously, empathize the difference for the parameters considered between the two areas. Considering only the differential species, a difference in light, temperature, moisture, and again reaction number are also evident. This difference could be due to the different structure of the stands, in the upper part prevail plants from sexual reproduction, which are bigger and taller, and characterized by a greater canopy development, while in the lower area the plants are of agamic origin (shoots), smaller both in height than diameter, and with a less developed canopy cover. The presence of a higher number of silver fir trees in the upper study area could be the reason for higher soil acidity in comparison to that of the lower study area. For this reason in the lower area prevail moss species characterized by a more temperate ecology, up to those of xeric or mediterranean environments (e.g., *Barbula unguiculata, Grimmia pulvinata, Schistidium apocarpum, Syntrichia ruralis*), while in the upper area, at the limit of the timber belt, prevail species preferring colder climates, up to some with a more montane ecology (e.g., *Dicranum majus*, *Isopterygiopsis pulchella, Pterigynandrum filiforme, Schistidium rivulare*).

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Table 2. Differential Moss species according to the altitudinel gradient.
L= Light number; **T**= Temperature number; **C**= Continentality number; **M**= Moisture number; **R**= Reaction number. **X**= taxa not ranked ecologically (ruderal species or species with ample distribution); *= value not assigned (Düll 1991).

(Lower elevation)	**L**	**T**	**C**	**M**	**R**
Barbula unguiculata	7	X	5	2	*7*
Cratoneuron filicinum	7	X	5	7	7
Ctenidium molluscum	6	4	5	4	8
Encalypta streptocarpa	5	X	5	5	8
Eurhynchium hians	7	4	5	5	7
Eurhynchium schleicheri	5	5	5	4	8
Eurhynchium striatum	5	6	3	5	6
Grimmia pulvinata	1	5	5	1	7
Homalothecium philippeanum	5	7	7	4	8
Homalotecium sericeum	8	3	5	2	7
Leptodon smithii	8	8	3	4	6
Orthotrichum affine	8	4	5	4	6
Plagiomnium undulatum	4	3	5	6	6
Pleurochaete squarrosa	9	8	5	2	6
Schistidium apocarpum	4	X	5	3	7
Scleropdium purum	6	4	5	4	5
Scleropodium touretii	8	7	4	3	6
Syntrichia ruralis	9	X	5	2	6
Timmia austriaca	4	1	6	6	8
Tortella tortuosa	5	X	6	4	8
MEDIAN	**6**	**5**	**5**	**4**	**7**

(Higher elevation)	**L**	**T**	**C**	**M**	**R**
Antitrichia curtipendula	6	3	4	4	6
Bryum capillare	5	X	5	5	6
Bryum subelegans	5	5	5	5	6
Dicranum majus	5	3	6	6	3
Distichium capillaceum	4	3	6	5	8
Fissidens viridulus var. tenuifolius	3	4	5	6	9
Habrodon perpusillus	6	8	3	5	5
Herzogiella seligeri	5	4	6	5	4
Hypnum andoi	3	4	3	6	3
Hypnum resupinatum	6	5	3	5	3
Isopterygiopsis pulchella	4	2	6	6	8
Isothecium striatulum	3	5	4	4	8
Leucodon sciuroides	8	5	5	4	6
Neckera pumila var. *pilifera*	5	3	4	5	5
Orthotrichum speciosum	7	2	6	5	5
Orthotrichum lyellii	7	4	4	4	5
Orthotrichum pallens	4	2	6	4	5
Pterigynandrum filiforme	6	2	6	5	4
Rhyncostegiella tenella	4	5	4	3	8
Rhynchostegium confertum	4	5	4	5	6
Schistidium rivulare	X	2	6	8	4
Zygodon forsteri	6	6	2	6	6
Zygodon rupestris	6	4	4	5	7
MEDIAN	**5**	**4**	**5**	**5**	**6**

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