Cryptogamie, Bryologie, 2009, 30 (1): 67-77
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The bryophyte flora of the Gargano Promontory (Apulia, south-eastern Italy)

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(Received 7 April 2008, accepted 22 July 2008)

Abstract – This study on the bryophyte flora of some localities of the Gargano Promontory includes 188 *taxa,* of which 23 are liverworts and 165 are mosses. Among them, 5 hepatic and 38 moss species are newly reported for the Apulia Region (south-eastern Italy), while the finding of *Gymnostomum lanceolatum* is the first report for Italy.

Riassunto – È stata studiata la flora briologica di alcune località del Promontorio del Gargano. Questo contributo comprende 188 *taxa* di briofite (23 epatiche e 165 muschi). Cinque specie di epatiche e 38 muschi vengono segnalate per la prima volta per la Regione Puglia. Fra esse, *Gymnostomum lanceolatum* è segnalata per la prima volta per l'Italia.

Bryoflora / chorology / Gargano / Apulia / south-eastern Italy

INTRODUCTION

The Gargano Promontory has not been the subject of systematic, in-depth bryological investigations until now. Previous bryological works (Rabenhorst, 1849; Pasquale & Licopoli, 1873; Giordano, 1879; Hofmann, 1961; Häusler, 1984) offered only fragmentary and very vague reports for this area. Exceptions to this are the contributions of Bottini (1894), who reported 47 *taxa* of mosses from various localities of the Gargano, and Cortini Pedrotti & Troiano (1984) on the bryophyte flora of the Monte S. Angelo, reporting 68 bryophyte species (6 liverworts and 62 mosses). Before the present work, a total of 85 *taxa* had been reported from the Gargano Promontory, of which 6 were liverworts and 79 were mosses.

The present work reports the results of a series of studies conducted between 1986 and 2002 in the Bosco Quarto and on the shores of the Varano Lake (Fig. 1), two areas of the Gargano Promontory of great naturalistic and ecological interest, which host a bryophyte flora of particular biogeographic interest.

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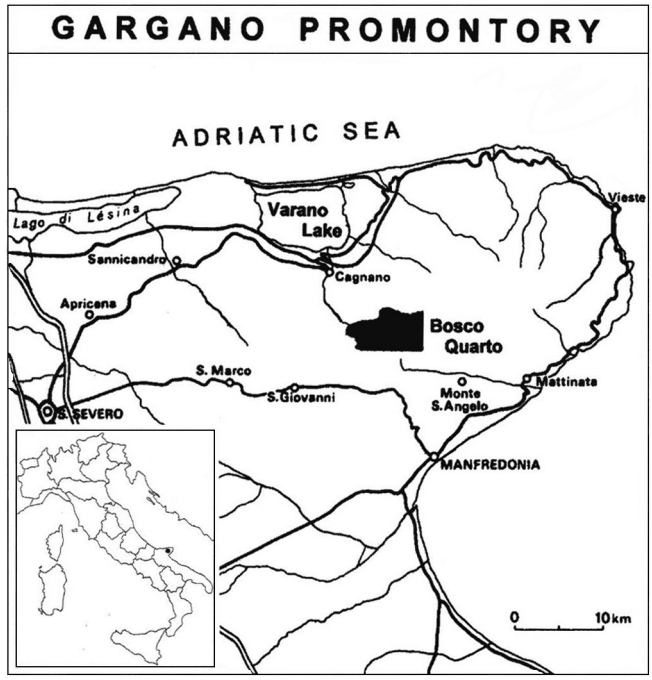

Fig. 1. Study area of the Bosco Quarto and Varano Lake in the Gargano Promontory.

STUDY AREA

The Gargano Promontory is an autonomous mountain chain, approximately 60 km long and 30 km wide, distinctly separated from the Apennines by the Foggia Highland, or "Tavoliere". It has the aspect of a flat montane relief formed by a series of high plains, the highest points of which are Monte Calvo (1065 m asl), Monte Nero (1014 m asl), and Monte Spigno (1008 m asl) (Falinski & Pedrotti, 1990). From the geological point of view, the Gargano is almost exclusively composed of sedimentary, calcareous rocks of the Cretaceous and the Jurassic. The great predominance of limestone gives the region a markedly Karstic physiognomy with numerous dolines, caves and caverns where rainwater enters and then flows out along the Adriatic shoreline. For this reason, the entire territory has no surface watercourses (Cortini Pedrotti & Troiano, 1984).

The Bosco Quarto covers an area of about 5,000 hectares in the municipal territory of Monte S. Angelo. It lies on an undulating high plain from 500 m to 850 m asl, formed of a series of parallel valleys that are cut by relief chains with rounded summits reaching altitudes of slightly less than 700 m. To the NE of the Bosco Quarto lies the Monte Spigno chain (1008 m asl), the summit of which consists of a high plain sloping prevalently NE-ward and containing numerous and sometimes quite large dolines.

The rainfall follows a typically Mediterranean pattern with winter and spring maxima and a considerable aridity in summer, though less than that of the regime prevailing along the coast. The mean annual temperature is 12.4 °C. As a consequence of the particular weather conditions on the Gargano, a marked compression of the vegetation belts occurs, as has already been reported by Fenaroli (1966a, 1966b, 1969, 1970, 1972, 1973, 1974); this can be particularly well noted in the Bosco Quarto, as well, where the ilex facing southward reaches 1000 m asl, whereas the beech wood on the northern slopes does not extend below an altitude of 620 m.

Though man's impact has been particularly intense in certain sectors of the Bosco Quarto, it still has well-preserved and considerably extensive areas of forest. These are all formed of mesophytic deciduous trees and only to a small extent of evergreen sclerophyllous ones. Among the former, there are beech forests (*Fagus sylvatica*) on the slopes to the north of Monte Spigno and mixed forests of *Carpinus betulus* and *Quercus cerris* on the left-hand slope of the valleys. The only evergreen sclerophyllous forest is that of ilex (*Quercus ilex*) with the *Ostryo-Quercetum ilicis* community.

The Varano Lake, located on the northern coast of the Gargano Promontory, covers approximately 60.5 km^2. This trapezoidal-shaped laguna between the promontory of Monte d'Elio and the point of Rodi Garganico is about 10 km wide and is inset about 7 km into the Promontory; its perimeter is about 33 km and its depth ranges from about 2 meters near the shore to about 5 meters at the center. To the north it is separated from the Adriatic Sea by a very narrow strip of land called the "isola" [island], about 10 km long and 1 km wide. The lake is fed by two subterranean springs and connects with the Adriatic through two channels.

In addition, because of numerous karst phenomena throughout the entire Gargano Promontory, the rainwater absorbed at the surface reemerges at the base of the mountain relief in correspondence with the coastline, where there are numerous springs fed by the principal groundwater of the Gargano. Short waterways (from 5-30 to 2100 meters) flow toward the sea from two types of springs: rheocrenic sources feed brooks of flowing water, while limnocrenic ones feed waterways with slow-moving water. Thus one can say that at the base of the Gargano, but always in its geographic sphere region, there are perennial short waterways with very characteristic flora and vegetation (Cortini Pedrotti *et al.*, 2003).

MATERIAL AND METHODS

In all, 19 localities and their environs were explored, with collection directed to all habitat types. The localities were assigned numbers, as in the following list.

The nomenclature for liverworts follows Ros *et al.* (2007), while that of mosses follows Hill *et al.* (2006) and Holyoak & Pedersen (2007). The chorological elements are drawn from Düll (1983, 1984, 1985, 1992). The samples have been deposited in the herbarium of the Department of Botany and Ecology of the University of Camerino (CAME).

List of localities explored:

1 Bosco Quarto UTM: 33TWG62
2 Caritate UTM: 33TWG72
3 Cutino del Rospo UTM: 33TWG72
4 Foce Varano UTM: 33TWG74
5 Foresta Umbra UTM: 33TWG72
6 Grotta Spagnola (S. Giuliano) UTM: 33TWG93
7 Lago di Varano UTM: 33TWG53/63
8 Porto Greco UTM: 33TWG93
9 Pulsano UTM: 33TWG71
10 Rodi Garganico UTM: 33TWG74
11 Sfilzi UTM: 33TWG72
12 Torre del Ponte UTM: 33TWG93
13 Turreti (Caldarasi) UTM: 33TWG93
14 Valle del Tesoro UTM: 33TWG72
15 Vico del Gargano UTM: 33TWG73
16 Vieste UTM: 33TWG93
17 Valle Pezzente UTM: 33TWG62
18 Valle Ragusa UTM: 33TWG62
19 Monte Spigno UTM: 33TWG6

RESULTS AND DISCUSSION

The 188 bryophytes (23 liverworts and 165 mosses) recorded in the study area are alphabetically listed, giving for each the corresponding locality numbers, and the substrata on which they were growing. Symbols are used to indicate some chorologically interesting facts: + not sighted since 1950, * new for Apulia region, ** new for Italy.

Liverworts

Cephaloziella baumgartneri Schiffn. – 7, 9, 11, 14 – on clayey, moist soil; tuff
Conocephalum conicum (L.) Dumort. – 5, 11 – on moist rocks
Frullania dilatata (L.) Dumort. – 1, 2, 3, 5, 11, 14, 17, 19 – on trees
****Frullania fragilifolia*** (Taylor) Gottsche *et al.* – 1 – on trees
Lejeunea cavifolia (Ehrh.) Lindb. – 1, 17, 18, 19 – on shaded slopes
****Lophocolea bidentata*** (L.) Dumort. – 5, 11 – on moist rocks
Lophocolea heterophylla (Schrad.) Dumort. – 11 – on decaying trunks
Lunularia cruciata (L.) Lindb. – 2, 5, 7, 9, 11, 14 – on slopes, in rock fissures, on moist walls
Marchantia polymorpha L. subsp. ***polymorpha*** – 15 – springs
Metzgeria furcata (L.) Dumort. – 1, 2, 5, 11, 17, 18, 19 – on trees
Pellia endiviifolia (Dicks.) Dumort. – 5, 7, 11, 15 – on moist rocks and caves
Pellia epiphylla (L.) Corda – 7 – springs
Porella cordaeana (Huebener) Moore – 17 – on moist rocks
Radula complanata (L.) Dumort. – 1, 2, 5, 11, 17, 19 – on trees
Radula lindenbergiana Gottsche *ex* C. Hartm. 1, 2, 5, 11 – on trees
Reboulia hemisphaerica (L.) Raddi – 3, 17 – in rocks fissures
Riccardia chamedryfolia (With.) Grolle – 7 – springs

**Riccardia multifida* (L.) Gray – 7 – on soil
Riccia fluitans L. – 7 – springs
**Riccia michelii* Raddi – 17, 19 – on moist soil
Riccia sorocarpa Bisch. – 1, 5, 17 – on soil
**Scapania aspera* Bernet *et* M.Bernet – 19 – on dolines rocks
Targionia hypophylla L. – 17 – in rocks fissures

Mosses

+Aloina aloides (Koch *ex* Schultz.) Kindb. – 9 – on slopes
+Aloina ambigua (Bruch *et* Schimp.) Limpr. – 7 – in rocks fissures
Anomodon viticulosus (Hedw.) Hook & Taylor – 1, 2, 5, 11, 14, 17 – on shaded slopes, trees and rocks
**Atrichum tenellum* (Röhl.) Bruch *et* Schimp. – 5 – on slopes
Atrichum undulatum (Hedw.) P. Beauv. – 18 – on shaded slopes
Barbula convoluta Hedw. – 1, 3, 4, 6, 7, 8, 9, 10, 12, 13, 15, 16, 17 – on soil and rocks
Barbula convoluta Hedw. var. ***sardoa*** Bruch & Schimp. – 19 – on rocks
Barbula unguiculata Hedw. – 1, 3, 4, 7, 8, 9, 12, 16, 17, 19 – on soil and rocks
Brachytheciastrum velutinum (Hedw.) Ignatov *et* Huttunen – 1, 5, 9, 17, 18 – on slopes and decaying trunks
Brachythecium campestre (Müll. Hal.) Schimp. – 1 – on shaded soil and slopes
**Brachythecium cirrosum* (Schwägr.) Schimp. – 5 – on slopes
Brachythecium glareosum (Bruch *ex* Spruce) Schimp. – 5, 19 – on shaded slopes
**Brachythecium mildeanum* (Schimp.) Schimp. – 5 – on soil
**Brachythecium rivulare* Schimp. – 11 – on moist soil and rocks
Brachythecium rutabulum (Hedw.) Schimp. – 1, 3, 5, 18, 19 – on shaded soil and slopes, on *Acer*
Brachythecium salebrosum (Hoffm. *ex* F. Weber *et* D. Mohr) Schimp. – 1, 5, 17, 19 – on shaded soil, on trees, on decaying trunks
Bryoerythrophyllum recurvirostrum (Hedw.) P.C. Chen – 19 – on rocky slopes
Bryum dichotomum Hedw. – 5 – on soil after fire
Bryum elegans Nees – 1 – on soil
**Bryum moravicum* Podp. – 17, 18, 19 – on doline rocks, on *Carpinus*
Bryum radiculosum Brid. – 1, 4, 7, 10, 16, 17 – on soil and rocks
Bryum ruderale Crundw. *et* Nyholm – 8, 9, 10, 17 – on soil and slopes
Bryum torquescens Bruch & Schimp. – 1, 5, 7, 8, 16, 18, 19 – on soil and moist rocks
Campyliadelphus chrysophyllus (Brid.) R.S. Chopra – 19 – on shaded slopes
Campylophyllum calcareum (Crundw. *et* Nyholm) Hedenäs – 17 – on shaded slopes
Cheilothela chloropus (Brid.) Broth. – 1 – on soil
+Cirriphyllum crassinervium (Taylor) Loeske *et* M. Fleisch. – 1, 19 – on rocky slopes
Cratoneuron curvicaule (Jur.) G. Roth – 7, 15 – on soil near spring
Ctenidium molluscum (Hedw.) Mitt. – 19 – on slopes
Dicranella howei Renauld *et* Cardot – 4, 6, 8, 9, 10, 12, 13, 16 – on slopes
+Dicranella varia (Hedw.) Schimp. – 1, 5, 10 – on shaded soil and slopes, on trees
Didymodon acutus (Brid.) K. Saito – 4, 9, 10, 16 – on soil
**Didymodon cordatus* Jur. – 17 – on soil
Didymodon fallax (Hedw.) R.H. Zander – 9 – on soil

Didymodon insulanus (De Not.) M.O. Hill – 1, 5, 17, 18, 19 – on dry wall, on shaded soil, slopes and rocks
Didymodon luridus Hornsch. – 4, 6, 7, 8, 9, 10, 12, 13, 16, 19 – on soil and rocks
Didymodon rigidulus Hedw. – 5, 9 – on soil
Didymodon sicculus M.J. Cano, Ros, García-Zamora *et* J. Guerra – 10 – on clayey soil
Didymodon sinuosus (Mitt.) Delogne – 17, 19 – on soil and rocks
Didymodon tophaceus (Brid.) Lisa – 7, 11 – tuff
Didymodon vinealis (Brid.) R.H. Zander – 3, 4, 6, 7, 8, 9, 10, 13, 16, 19 – on soil and rocks
Ditrichum flexicaule (Schwägr.) Hampe – 19 – on rocks
Encalypta streptocarpa Hedw. – 5, 19 – in rocks fissures
+***Encalypta vulgaris*** Hedw. – 5 – in rocks fissures
****Enthostodon fascicularis*** (Hedw.) Müll. Hal. – 17 – on shaded meadow
+***Enthostodon obtusus*** (Hedw.) Lindb. – 10 – waterfall
Eucladium verticillatum (With.) Bruch *et* Schimp. – 5, 7, 10, 11, 15, 16 – on tuff and shaded caves
Eurhynchiastrum pulchellum (Hedw.) Ignatov *et* Huttunen – 2, 5, 11, 14, 19 – on shaded slopes
Eurhynchium striatum (Hedw.) Schimp. – 1, 5, 14 – on slopes and rocks
Fissidens bryoides Hedw. – 17 – on soil
Fissidens crispus Mont. – 14 – on shaded slopes
Fissidens dubius P. Beauv. – 1, 19 – on shaded slopes and rocks, on trees
****Fissidens ovatifolius*** R. Ruthe – 2 – on slopes
****Fissidens serrulatus*** Brid. – 1, 5 – on shaded soil
Fissidens taxifolius Hedw. – 5, 10, 18 – on soil and slopes
Fissidens viridulus (Sw. *ex* anon.) Wahlenb. var. ***viridulus*** – 5, 8 – in rocks fissures
Fissidens viridulus (Sw. *ex* anon.) Wahlenb. var. ***incurvus*** (Starke ex Röhl.) Waldh. – 7, 9 – in rocks fissures, on moist walls
****Fontinalis antipyretica*** Hedw. subsp. ***antipyretica*** – 7 – spring
Fontinalis antipyretica Hedw. subsp. ***gracilis*** (Lindb.) Schimp. – 7 – spring
****Fontinalis hypnoides*** C. Hartm var. ***duriaei*** (Schimp.) Kindb. – 7 – spring
Funaria hygrometrica Hedw. – 1, 3, 5 – on soil after fire
Grimmia pulvinata (Hedw.) Sm. – 1, 5, 13, 17, 18, 19 – on dry wall and rocks
Grimmia trichophylla Grev. – 5, 13 – on dry wall
Gymnostomum aeruginosum Sm. – 4, 7 – on dunes and soil
Gymnostomum calcareum Nees *et* Hornsch. – 2, 5, 7, 9, 10, 14, 16 – on soil, in rocks fissures, caves, waterfalls
*****Gymnostomum lanceolatum*** M.J. Cano, Ros *et* J. Guerra – 7 – on sandstone
Gymnostomum viridulum Brid. – 7, 19 – on rocky slopes, on moist rocks
Gyroweisia tenuis (Hedw.) Scimp. – 5, 11 – in rocks fissures
+***Habrodon perpusillus*** (De Not.) Lindb. – 1, 5, 17, 19 – on trees
****Herzogiella seligeri*** (Brid.) Z. Iwats. – 1, 5 – on moist slopes
Homalia lusitanica Schimp. – 14 – on moist slopes
Homalothecium lutescens (Hedw.) H. Rob. – 1, 9 – in rocks fissures
Homalothecium sericeum (Hedw.) Schimp. – 1, 2, 3, 5, 7, 9, 10, 13, 16, 17, 18, 19 – on rocks and slopes, on trees
Hygroamblystegium humile (P. Beauv.) Vanderp., Goffinet *et* Hedenäs – 7 – spring
Hypnum andoi A.J.E. Sm. – 19 – on slopes
Hypnum cupressiforme Hedw. var. ***cupressiforme*** – 1, 2, 3, 5, 11, 14, 17 – on trees and decaying trunks

Hypnum cupressiforme* Hedw. var. ***filiforme* Brid. – 1, 5, 19 – on trees
Hypnum cupressiforme* Hedw. var. ***lacunosum* Brid. – 1, 5, 14 – on trees and rocks
Hypnum cupressiforme Hedw. var. ***resupinatum*** (Taylor) Schimp. – 17, 19 – on shaded slopes, on trees
Hypnum cupressiforme* Hedw. var. ***subjulaceum* Molendo – 1 – on rocks
Isothecium alopecuroides (Lam. *ex* Dubois) Isov. – 1, 5, 17, 18 – on trees and rocks
Kindbergia praelonga (Hedw.) Ochyra – 17, 18 – on soil and slopes
Leptodictyum riparium (Hedw.) Warnst. – 7, 19 – springs, dolines
Leptodon smithii (Hedw.) F. Weber *et* D. Mohr. 1, 2, 3, 5, 10, 13, 14, 17, 18, 19 – on trees
*+**Leskea polycarpa*** Hedw. – 1, 5 – on trees
Leucodon sciuroides (Hedw.) Schwägr. – 1, 2, 3, 5, 6, 11,13, 17, 19 – on trees
*+**Leucodon sciuroides*** (Hedw.) Schwägr. var. ***morensis*** (Schwägr.) De Not. – 1, 19 – on doline soil, on rocks
Microbryum starkeanum (Hedw.) R.H. Zander – 19 – on rocks
Mnium stellare Hedw. – 18 – on rocks
Neckera complanata (Hedw.) Huebener – 1, 5, 17, 18 – on soil, rocks and trees
**Neckera pennata* Hedw. – 1, 5 – on trees
**Neckera pumila* Hedw. – 1, 5, 17, 18 – on trees
Orthotrichum affine Schrad. *ex* Brid. – 1, 5, 17, 19 – on trees
Orthotrichum anomalum Hedw. – 1, 5, 8, 19 – on rocks
*+**Orthotrichum cupulatum*** Hoffm. *ex* Brid. – 1, 19 – on rocks, on shaded soil
Orthotrichum diaphanum Schrad. *ex* Brid. – 1, 5, 6, 13, 17 – on trees
**Orthotrichum lyellii* Hook. *et* Taylor – 1, 2, 3, 5, 11, 14, 17, 19 – on trees
*+**Orthotrichum stramineum*** Hornsch. *ex* Brid.- 1 – on decaying trunks
*+**Orthotrichum striatum*** Hedw. 1, 2, 3, 5 – on trees
**Orthotrichum urnigerum* Myrin – 19 – on shaded rocks
Oxyrrhynchium hians (Hedw.) Loeske – 18 – on shaded slopes
Oxyrrhynchium pumilum (Wilson) Loeske – 1, 17, 19 – on shaded, moist soil and rocks
Oxyrrhynchium schleicheri (R. Hedw.) Röll. – 1, 5, 10, 17, 19 – on soil, rocks, slopes, waterfall
**Palustriella commutata* (Hedw.) Ochyra – 10 – waterfall
Plagiomnium affine (Blandow *ex* Funck) T.J. Kop. – 1, 11, 15, 17, 18, 19 – on shaded slopes
Plagiomnium cuspidatum (Hedw.) T.J. Kop. – 19 – on slopes
**Plagiomnium ellipticum* (Brid.) T.J. Kop. – 3, 5 – on slopes
Plagiomnium medium (Bruch *et* Schimp.) T.J. Kop. – 1, 18 – on rocks
Plagiomnium rostratum (Schrad.) T.J. Kop. – 1, 2, 11, 14, 17 – on slopes
Plagiomnium undulatum (Hedw.) T.J. Kop. – 3, 5, 11, 14, 19 – on slopes
Plasteurhynchium striatulum (Spruce) M. Fleisch. – 19 – on rocky slopes
Platyhypnidium riparioides (Hedw.) Dixon – 7, 15 – springs
Pleurochaete squarrosa (Brid.) Lindb. – 1, 3, 4, 6, 7, 8, 9, 10, 12, 13, 16, 17, 19 – on soil and rocks
**Pohlia cruda* (Hedw.) Lindb. – 7 – on moist caves
**Pohlia lescuriana* (Sull.) Ochi – 7 – on moist caves
**Polytrichastrum formosum* (Hedw.) G.L. Sm. – 1, 2, 5, 11 – on shaded soil
Pseudocrossidium hornschuchianum (Schultz) R.H. Zander – 6, 7, 8, 9, 12, 16 – on soil
**Pseudoleskea radicosa* (Mitt.) Macoun *et* Kindb. – 7 – on moist caves
*+**Pseudoleskeella catenulata*** (Brid. *ex* Schrad.) Kindb. – 13, 17 – on dry wall, on trees

Pseudoleskeella nervosa (Brid.) Nyholm – 19 – on rocky slopes
Pseudoscleropodium purum (Hedw.) M.Fleisch. – 1, 19 – on soil and rocky slopes
Pterogonium gracile (Hedw.) Sm. – 1, 2, 13, 17, 18, 19 – on slopes, dry wall and rocks, on *Carpinus*
+***Pterigynandrum filiforme*** Hedw. – 1, 19 – on *Fagus*
Ptychostomum capillare (Hedw.) D.T. Holyoak *et* N. Pedersen – 1, 3, 4, 5, 6, 9, 12, 16, 17, 18, 19 – on shaded soil and slopes, on trees
Ptychostomum donianum (Grev.) D.T. Holyoak *et* N. Pedersen – 8, 17 – on soil
Ptychostomum imbricatulum (Müll.Hal.) D.T. Holyoak *et* N. Pedersen – 1, 3, 7, 10, 12, 17, 19 – on soil and rocks
Ptychostomum rubens* (Mitt.) D.T. Holyoak *et* N. Pedersen – 5, 17 – on soil after fire, on slopes
Pylaisia polyantha* (Hedw.) Schimp. 1, 5 – on trees
Rhynchostegiella curviseta* (Brid.) Lindb. – 7 – springs
Rhynchostegiella litorea (De Not.) Limpr. – 3, 7, 8, 9, 10, 12, 16 – in rocks fissures, on slopes
Rhynchostegiella tenella (Dicks.)Limpr. – 1, 5, 7, 10, 14, 17, 18, 19 – in rocks fissures, on slopes
Rhynchostegium confertum (Dicks.) Schimp. – 1, 2, 5, 11, 14 – on slopes
Rhynchostegium megapolitanum (Blandow *ex* F. Weber *et* D. Mohr) Schimp. – 5, 11, 16 – on slopes
Schistidium apocarpum (Hedw.) Bruch *et* Schimp. – 19 – on rocks
Schistidium crassipilum H.H. Blom – 1, 17, 18, 19 – on shaded slopes and rocks
Schistidium helveticum (Schkuhr) Deguchi – 19 – on rocks
Scleropodium touretii (Brid.) L.F. Koch – 3, 5, 7, 8, 9, 19 – on slopes
Scorpiurium circinatum (Bruch) M. Fleisch *et* Loeske – 1, 2, 3, 5, 7, 8, 9, 10, 12, 14, 19 – on slopes and rocks
Syntrichia calcicola* J.J. Amann – 9 – on rocks
+***Syntrichia laevipila*** Brid. – 1, 6, 13 – on trees and rocks
Syntrichia montana Nees – 5, 7, 8, 9, 12, 13, 17, 19 – on rocks
Syntrichia ruralis (Hedw.) F. Weber *et* D. Mohr – 2 – on slopes
Syntrichia virescens* (De Not.) Ochyra – 1, 13, 17 – on dry wall, on trees
Thamnobryum alopecurum (Hedw.) Gangulee – 5, 11, 14 – on moist rocks
Tortella flavovirens (Bruch) Broth. – 4, 7, 12, 16 – on dunes and sandy soil
+***Tortella inclinata*** (R. Hedw.) Limpr. – 1, 9 – in rock fissures, on sandy soil
Tortella nitida (Lindb.) Broth. – 4, 7, 9, 16 – in rock fissures
Tortella tortuosa (Hedw.) Limpr. – 5, 11, 19 – on slopes
+***Tortula cuneifolia*** (Dicks.) Turner – 7 – on rocks, springs
Tortula freibergii* Dixon *et* Loeske – 15 – on soil near the spring
Tortula marginata (Bruch *et* Schimp.) Spruce – 7 – on rocks near the spring
Tortula mucronifolia* Schwägr. – 13 – on dry wall
Tortula muralis Hedw. – 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18 – on rocks, dry wall, rocky soil
Tortula obtusifolia* (Schwägr.) Mathieu – 13 – rocks
Tortula subulata Hedw. – 2, 7, 19 – on soil and moist sandstone, on shaded slopes
Trichostomum brachydontium Bruch. – 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 15, 16, 17 – on soil
Trichostomum crispulum Bruch. – 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 15, 16, 17, 19 – on soil, slopes and rocks
Trichostomum triumphans* De Not. – 7 – on sandstone
Ulota crispa* (Hedw.) Brid. – 18 – on *Carpinus*
Weissia brachycarpa (Nees *et* Hornsch.) Jur. – 1, 10, 17 – on slopes and rocks

Weissia condensa (Voit.) Lindb. – 4, 9 – on soil, in rock fissures
Weissia controversa Hedw. – 1, 3, 5, 7, 8, 9, 10, 12, 13, 16, 19 – on soil and rocks
Weissia longifolia Mitt. – 9 – in rock fissures
****Weissia wimmeriana*** (Sendtn.) Bruch *et* Schimp. – 8, 9 – in rock fissures
Zygodon rupestris Schimp. *ex* Lorentz. – 1, 5, 17 – on trees

The currently known bryophyte flora of the Gargano area comprises 188 bryophyte *taxa* (23 liverworts and 165 mosses), including 5 liverworts and 38 mosses that according to Aleffi *et al.* (2008) are new for the Apulia Region. This is the first report for *Gymnostomum lanceolatum* in Italy, while the finding of *Didymodon sicculus* is the fourth report for Italy.

Some species with few reports in Italy have been recorded here: *Fontinalis hypnoides* var. *duriaei* is quite rare in Italy, having been reported recently only from Emilia-Romagna, Tuscany, Sardinia and Sicily. Among the other species new to the Apulia Region is a group that develops on the banks of the springs along the coastline near the Varano Lake, including *Pellia epiphylla, Riccardia chamedryfolia* and *Riccia fluitans* among the liverworts, and *Cratoneuron curvicaule*, *Fontinalis antipyretica* subsp. *gracilis*, *Leptodictyum riparium* and *Platyhypnidium riparioides* among the mosses. Though fairly common in Italy and other Mediterranean countries, these species are quite rare in the Apulia Region and southern Italy, due to the arid climate and scarcity of springs and moist environments.

Of chorological interest are some bryophytes found in forest environments. *Atrichum tenellum* was recorded on the slopes of the Foresta Umbra; this very rare boreal-montane species has been reported in Italy only in the regions of Piedmont, Lombardy, and Trentino-Alto Adige. *Bryum moravicum*, instead, was found in a variety of stations of the Bosco Quarto (Pezzente and Ragusa Valleys), in particular on the doline rocks of Monte Spigno and on the trunks of *Carpinus*. This temperate species has been reported from Italy only in Lombardy and Trentino-Alto Adige. *Fissidens ovatifolius,* also found on the slopes of the Foresta Umbra, is a suboceanic-mediterranean species that has been recently reported only from some regions of southern Italy (Campania, Sardinia and Sicily). Some species of the *Tortula* genus have been recorded on the rocks near the springs along the coast. *Tortula freibergii*, a suboceanic species rare in Italy, had been reported only from Tuscany and Sicily. *Tortula mucronifolia* is a boreal-montane species reported from northern Italy as far as Tuscany, and thus the Gargano station is the southernmost reported to date in Italy. *Tortula obtusifolia* is a rare temperate-montane species whose presence in Italy is limited to Piedmont and Emilia-Romagna (Aleffi *et al.*, 2008; Cortini Pedrotti, 2001, 2005).

Finally, some noteworthy species found along the coast near springs and moist rocky walls include *Pohlia lescuriana*, a suboceanic species that was found on the moist walls of caves near the Varano Lake, and was recently reported only from Trentino Alto-Adige, Friuli-Venezia Giulia and the Marches. Also found in these environments was *Pseudoleskea radicosa*, a species distributed in northern Italy and, in the south, in the Molise and Sicily.

The finding of *Gymnostomum lanceolatum* is the first report for Italy (Aleffi *et al.*, 2004b). The species has been described from Spain (Cano *et al.*, 1994) and later recorded in other Mediterranean countries: Croatia (Sabovljević, 2006), Turkey (Kučera, 1998) and Southern Greece (Blockeel *et al.*, 2002). Probably this species is rather more widely distributed in the Mediterranean area, but has been overlooked or misidentified. The Italian specimens of this species

were growing in partial shade on arenaceous rocks quite close to the sea line (ca 10 m). Some authors consider it a variety of *G. calcareum* Nees *et* Hornsch. (Sérgio, 2006).

Didymodon sicculus appears to be changing from a Spanish endemic (Cano *et al.*, 1996) to a Mediterranean species, judging by its reports in other Mediterranean countries: Montenegro (Cvetić & Sabovljević, 2004), Turkey (Papp & Sabovljević, 2003), and Greece (Blockeel *et al.*, 2002). In Italy, the species was collected in the Marches Region at the edge of the slopes of Monte Conero (Aleffi *et al.*, 2003, 2004a) and in Calabria and Sicily (Puglisi *et al.*, 2004). Thus the Gargano station is the fourth report for this species for Italy. The specimens of the Gargano Promontory were growing in coastal zones near Rodi Garganico, in semi-shaded conditions on saline loamy soil quite close to the sea line (ca. 10 m).

Acknowledgements. The authors would like to thank Sheila Beatty, professor of English at the University of Camerino, for the translation and linguistic revision of the manuscript.

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