Nova Hedwigia **82** 1—2 31—50 Stuttgart, February 2006

Lichen diversity from Cazorla, Segura and Las Villas Biosphere Reserve (SE Spain)

by

G. Aragón*[1], V.J. Rico** and R. Belinchón*

*Área de Biodiversidad y Conservación, ESCET, Universidad Rey Juan Carlos, c/ Tulipán s/n, 28933-Móstoles (Madrid), Spain.

**Departamento de Biología Vegetal II, Facultad de Farmacia, Universidad Complutense. Plaza de Ramón y Cajal, s.n., E-28040-Madrid, Spain.

With 1 figure and 3 tables

Aragón, G., V.J. Rico & R. Belinchón (2006): Lichen diversity from Cazorla, Segura and Las Villas Biosphere Reserve (SE Spain). - Nova Hedwigia 82: 31-50.

Abstract: The lichen flora from "Cazorla, Segura and Las Villas" mountains (SE Spain)" was investigated. A total number of 125 genera and 497 species were reported. *Involucropyrenium waltheri, Placynthium asperellum, Strangospora deplanata, Verrucaria cinereoviridescens* and *V. polysticha* are new cites for Spain and 267 taxa are new to the lichen flora of Jaén province. Other taxa (*Agonimia allobata, A. octospora, Aspicilia lignicola, Bacidia absistens, B. subincompta, Bryoria capillaris, Calicium montanum, Caloplaca adriatica, Caloplaca assigena, Catapyrenium daedaleum, Lecanora coniferarum, L. densa, Lecidea hypopta, Leptogium burnetiae, Leptogium cretaceum, L. imbricatum, L. microphylloides, L. subaridum, Macentina dictyospora, Melaspilea urceolata, Placynthium hungaricum, Psora globifera, Psoroglaena stigonemoides, Protoparmelia oleagina, Psorotrichia frustulosa, Rinodina castanomela, R. dalmatica, R. furfuracea, Verrucaria canella, V. sorbinea* and *V. transiliensis*) were specially considered due to their chorological and ecological implications within southern Europe regions. Valleys and ravines with dense forests stands (*Quercus faginea, Q. rotundifolia*) contain the highest lichen diversity (240 to 290 per km^2) and the highest number of cyanophyllous species (45 to 65 per km^2). Epiphytic lichen flora is different in humid and drier *Pinus nigra* forests. The major epiphytic diversity was located on bark of *Q. faginea* and *Q. rotundifolia* in well-preserved forests. Most terricolous species grew upper 1650 m altitude. Finally the majority of saxicolous lichens were found on vertical exposed rocks, in humid conditions, at altitudes from 1550 up to 1750 m. The lichen flora of the survey area is characterized by the high incidence of boreal-montane and temperate-oceanic element in epiphytic lichens and temperate-continental element in saxicolous and terricolous lichens.

[1]Corresponding author
E-mail: gregorio.aragon@urjc.es; rocio.belinchon@urjc.es

DOI: 10.1127/0029-5035/2006/0082-0031 0029-5035/06/0082-0031 $ 5.00

Introduction

Since 1978, when the UNESCO declared the first Biosphere Reserve, 440 regions of 97 countries have been added in order to develop an International Network of Reserves. In Spain, 26 reserves include the most important natural ecosystems with great biological diversity and natural features of exceptional scientific interest. “Cazorla, Segura and Las Villas” mountains were declared as an UNESCO Biosphere Reserve on 1983.

This area is located in SE Spain (Jaén prov.), inside the Betic Mountains. The zone is characterized by a diverse landscape including high calcareous mountains covered by black pine forests, small mountains with olive grove, humid valleys with deciduous oak, numerous ravines and canyons with holm oak forests, and stony slopes covered of junipers formations. In spite of the geographic location within the Mediterranean Region, the abundance of rainfall (> 1000 mm) allows the existence of a great leafiness.

Historically, the first studies about the lichen species were published by Moreno et al (1987), who investigated the epiphytic lichens of “river Madera”. Later, Aragón & Rico (1997) studied the macrolichens of “Sierra de Segura”. However, most regions within the Reserve have been poorly investigated and only a few data were added into a greater taxonomic context (e.g. Degelius, 1954; Aragón & Otálora, 2004; Aragón & Sarrión 2003; Aragón et al. 2004, 2005; Martínez & Aragón 2004; Sarrión et al. 1999, 2003). These reserchs resulted in 217 species cited in this area. The present study has provided new information about the lichens of “Cazorla, Segura and Las Villas mountains” Reserve.

Survey area

With a large extension of 214.300 ha, the survey area is located into the Betic Mountains (southeastern Spain) and it is framed by the “Sierras of Cazorla, Segura and Las Villas” Reserve. This area, represents the most extensive Natural Park of Spain (NE of Jaén Province) (Fig. 1). The river Guadalquivir rises in the Sierra de Cazorla, amid some of the highest calcareous mountains in Spain, and gives its name to the valley bounded by these mountains. The altitudinal rank comprises from 2107 m, of the highest peak “Empanadas”, up to 540 m height, corresponding to the “Tranco de Beas” reservoir. The studied area, with more than 20 rivers and brooks, includes several ravines and valleys adjacent to the main valley of the Guadalquivir, such as the Guadalentín and the canyons of Borosa and Aguamulas. The studied sustrate is characterized by hard limestone from the Jurasic to Cretacic periods. The climate is typically Mediterranean, with Pm= 600 (Pozo Alcón) to 1307 mm (Cañada de las Fuentes) and T= 17°C (Beas de Segura) to 6°C upper 2000 m alt. The weather pattern provides abundant rainfall, particularly during the summer thunderstorms due to the special situation of these high mountains (cf. Aragón & Otálora, 2004, pag. 365). From a bioclimatical point of view, the area belongs to the meso- (540 to 1200 m alt.), supra- (1200 to 1650 m alt.), and oromediterranean belts (>1700 m alt.). Phytoclimatically, the studied area belongs to the “Subbetic sector of Betic Province” (Rivas-Martínez 1987). Forest vegetation is discussed in the Material and Methods section.

Material and methods

A total number of 5000 specimens were collected in 53 different localities and were included in MA and MAF herbaria. An analysis of secondary lichen products in *Bryoria*, *Lecanora*, *Punctelia* and *Usnea* genera was performed from acetone extracts by thin layer chromatography (TLC) according to standardized procedures (White & James 1985). Current mycological terminology follows Kirk et al. (2001).

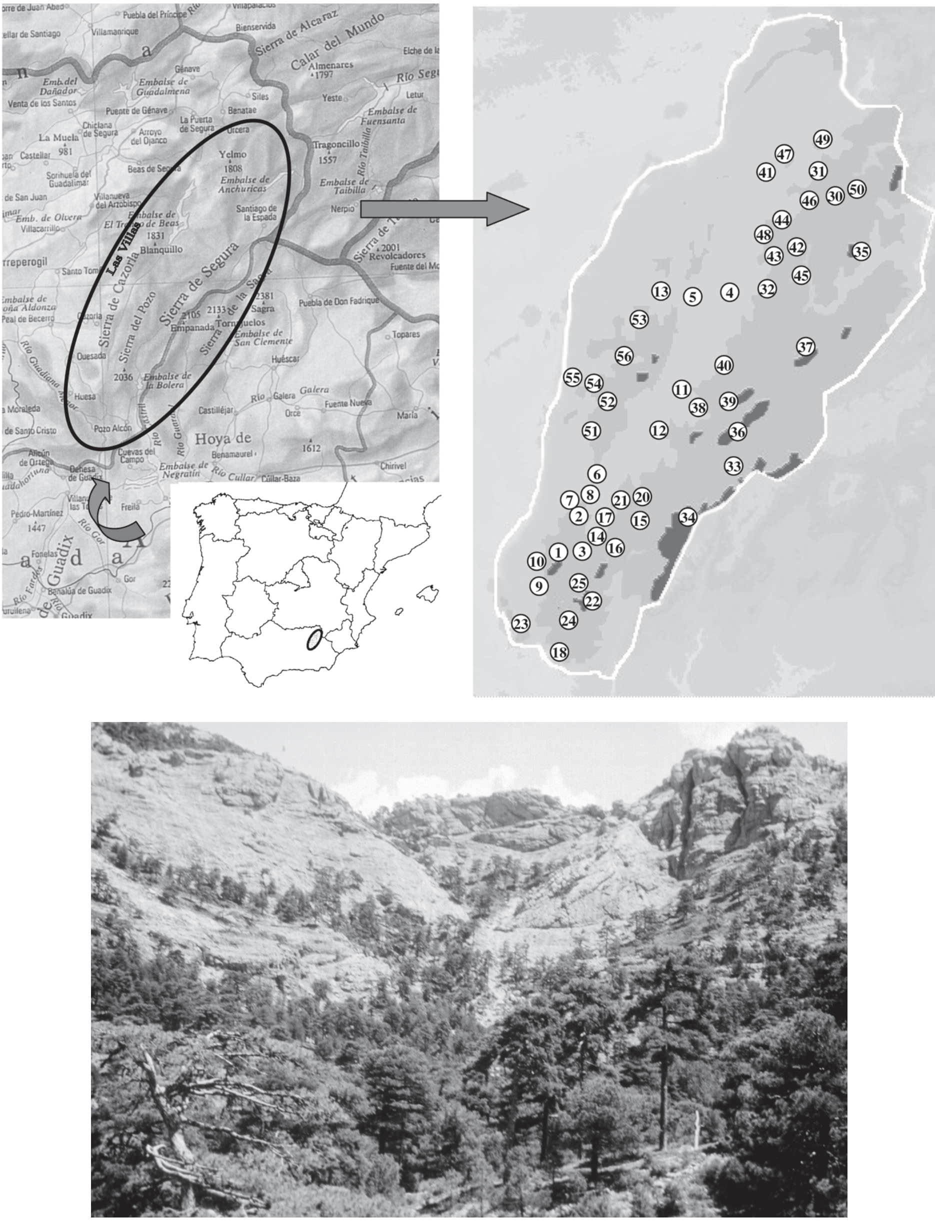

Fig. 1: Map of the studied area showing the locations of the 53 collection sites, and a representative *Pinus nigra* forest.

In the list of taxa, the abundance of each species is indicated and the number of localities where the taxa appeared are included between brackets. Abbreviations of substrata and altitudinal rank are added. Before the name of the species, first provincial records are pointed with (*). Wirth (1995) and Hafellner & Türk (2001) were followed in the nomenclatural aspects, except for the most recently monographied taxa. Habit abbreviations are shown in table 1.

Table 1: Habit and forophytes abbreviations.

Habit	Forophytes	
bri (mossess)	Ag (*Acer granatense*)	Pav (*Prunus avium*)
cal (saxicolous-calcicolous)	Am (*Acer monspessulanum*)	Ph (*Pinus halepensis*)
terr (terricolous)	Au (*Arbutus unedo*)	Pha (*Phillyrea angustifolia*)
cor (corticolous)	Bs (*Buxus sempervirens*)	Pla (*Platanus* sp.)
lig (lignicolous)	Ca (*Corylus avellana*)	Pn (*Pinus nigra*)
liq (lichenicolous)	Cm (*Crataegus monogyna*)	Pon (*Populus nigra*)
	Dl (*Daphne laureola*)	Ppr (*Pinus pinaster*)
	Ea (*Erica arborea*)	Pt (*Pistacia terebinthus*)
	Fa (*Fraxinus angustifolia*)	Qc (*Quercus coccifera*)
	Hh (*Hedera helix*)	Qf (*Quercus faginea*)
	Jh (*Juniperus hemisphaerica*)	Qp (*Quercus pyrenaica*)
	Jo (*Juniperus oxycedrus*)	Qr (*Quercus rotundifolia*)
	Jp (*Juniperus phoenicea*)	Ro (*Rosmarinus officinalis*)
	Oe (*Olea europaea*)	Ug (*Ulmus glabra*)

Collection sites arranged by vegetation types

1- From 540 up to 1200 m altitude (mesomediterranean belt, about 35% of the territory). The vascular vegetation is represented on the lower slopes by pine plantations: aleppo pine (*Pinus halepensis*) (4, 5, 12, 18, 41, 51) and maritime pine (*P. pinaster*) (1, 2, 10, 19, 32). Both pines have been used for silvicultural plantation. Therefore there are extensive areas covered by *Olea europaea* growing (5, 12). Oaks-holm forests are also common and cover large extensions in deep ravines. The more humid areas are enriched with *Quercus faginea, Buxus sempervirens* and *Arbutus unedo* (28, 38, 39). In drier localities, the landscape structure is composed by *Quercus coccifera, Quercus rotundifolia, Rhamnus lycioides, Rosmarinus officinalis* and *Lavandula latifolia* (13, 17, 20, 23, 27, 54). When these forests have been degraded, dense shrublands (*Rosmarinus, Lavanda, Thymus*) spread (29, 47).

2- From 1200 to 1650 m altitude (supramediterranean belt, over 65% of the territory). One of the most relevant relictics forests are *Quercus faginea* formations. Halfway through the XVIII century, these forests occuped a larger area of land (50% of the trees were *Q. faginea*). Although, between 1770 and 1800 m, the forested area was drastically reduced due to wood extraction for the naval industry and several forests fires (nowadays, less than 3.6% of the trees are *Q. faginea*). (Valle et al. 1989). Currently, they occur in very humid slopes and shady placed in the supramediterranean belt (6, 8, 30). This old-growth stand presents a canopy layer almost exclusively composed of *Quercus faginea*, but enriched under more humid conditions with other tree species, such as *Acer granatense, A. monspessulanum, Corylus avellana, Fraxinus angustifoli*a and *Ulmus glabra*. Results of the historical silvicultural facilitation, *Pinus nigra* forests cover vast areas of potentially *Quercus faginea* forests. Two type of black pine formation were studied for the lichenological point of view. A) Dense pine forests growing in valleys with humid conditions (Pm > 1.000 mm annual). The canopy layer is enriched by *Corylus avellana, Quercus faginea, Ilex aquifolium, Taxus baccata, Acer granatense, A. monspessulanum, Sorbus aria* and *Pteridium aquilinum* (9, 16, 24, 45, 49). B) Open pine forests growing on potentially area of *Quercus rotundifolia* forests, in stony hillsides with drier conditions (P< 850 mm) (7, 14, 15, 25, 42, 48, 50). The landscape structure consists of *Pinus nigra, Quercus rotundifolia, Juniperus phoenicea, Lavandula latifolia, Rosmarinus officinalis, Thymus mastichina, Cytisus reverchonii*, etc. (Roselló & Sánchez 1991). When potential forests were not cut down, these stony slopes are covering by open holm-oak forests. These formations are dominated by stunted *Quercus rotundifolia, Berberis hispanica, Crataegus monogyna* and *Rosa* sp. pl. (26, 31,

40, 43). Forest structure in more xeric conditions is dominated by junipers (*Juniperus phoenicea* and *J. oxycedrus*) on stony ground (52, 53, 56). Pyrenean oak (*Quercus pyrenaica*) forests occur on siliceous substrate, in humid supramediterranean belt. Finally, in the study area exist few populations growing on sandy sediment called "Facies de Utrillas". In this case, *Quercus pyrenaica, Pinus pinaster, P. nigra, Quercus faginea, Sorbus aria* and *S. torminalis* form the canopy (30).

3- From 1650 to 2100 m altitude (oromediterranean belt) (5% of the total area). Open pine black forests cover extensive areas of these high calcareous mountains. Ancients *Pinus nigra* are almost the only species that form the canopy of these forests (34, 35, 36, 44). The scrub layer is dominated by cushion chamaephytes (*Erinacea anthillis, Genista longipes, Vella spinosa*) and creeping mats such as *Daphne oleoides, Juniperus hemisphaerica, J. sabina* or *Prunus prostrata*. The high valleys, called navas, are covered with grasses (33, 37). Some of the mountains tops are treeless; occasionally this bareness is due to natural causes, but usually it is because overgrazing has tipped the ecological balance in favour of low-growing shrubs rather than trees. Detailed vegetation descriptions of the Biosphere Reserve are in Valle et al. (1989).

Results: list of taxa

**Acarospora cervina* A.Massal. - cal (18) 800-2080 m.

**Acarospora glaucocarpa* (Ach.) Körb. - cal (6) 850-1740 m.

**Acarospora laqueata* Stinzenb. - cal (1) 890 m.

**Acarospora macrospora* (Hepp) A.Massal. ex Bagl. - cal (5) 850-2028 m.

**Acrocordia cavata* (Ach.) R.C.Harris - cor (Ag, Ca) (2) 930-1350 m.

**Acrocordia conoidea* (Fr.) Körb. - cal (2) 1270-1350 m.

Agonimia allobata (Stizenb.) P.James - cor (Qr) (1) 850 m.

Agonimia octospora Coppins & P.James - cor (Qf, Qr) (6) 760-1270 m.

Agonimia opuntiella (Buschardt & Poelt) Vêzda - cor (Qr) (2) 850-1270 m.

Agonimia tristicula (Nyl.) Zahlbr. - cor (Qr)-liq (*Leptogium imbricatum, Peltigera canina*) (3) 1000-1270 m.

Amandinea punctata (Hoffm.) Coppins & Scheid. - lig (Jp, Qf) (3) 1000-1450 m.

Anaptychia ciliaris (L.) Körb. - cor (Bs, Jc, Jo, Jp, Oe, Pn, Qf, Qr) (19) 665-1740 m.

**Anema decipiens* (A.Massal.) Forssell - cal (1) 900 m.

**Anema nodulosum* (Nyl.) Forssell - cal (2) 760-900 m.

**Anema notarisii* (A.Massal.) Forssell - cal (1) 1180 m.

**Anema nummularium* (Durieu & Mont.) Nyl. - cal (2) 760-1150 m.

**Anthracocarpon virescens* (Zahlbr.) Breuss - terr (1) 760 m.

**Arthonia calcicola* Nyl. - cal (5) 890-1900 m.

**Arthonia didyma* Körb. - cor (Ia, Qr) (2) 850-1350 m.

**Arthonia pinastri* Anzi - cor (Ph) (2) 800-920 m.

**Arthonia punctiformis* Ach. - cor (Pn) (2) 1250-1450 m.

**Arthonia radiata* (Pers.) Ach. - cor (Am, Cm, Ia, Pt, Pon) (5) 900-1500 m.

Arthrosporum populorum A.Massal. - cor (Ph, Qr) (5) 760-1100 m.

**Aspicilia calcarea* (L.) Mudd - cal (28) 800-2028 m.

**Aspicilia cheresina* (Müll. Arg.) Hue - cal (6) 1150-1440 m.

Aspicilia contorta (Hoffm.) Kremp. - cal (15) 800-1900 m.

**Aspicilia coronata* (A.Massal.) Anzi - cal (13) 850-1900 m.

**Aspicilia farinosa* (Flörke) Arnold - cal (13) 830-1940 m.

Aspicilia hispida Mereschk. - terr (3) 1450-1790 m.

Aspicilia lignicola (Anzi) Hue - cor (Jo, Jp) (3) 950-1450 m.

**Bacidia absistens* (Nyl.) Arnold - cor (Qp) (1) 1270 m.

**Bacidia arceutina* (Ach.) Arnold - cor (Ag, Qf) (2) 930-1270 m.

**Bacidia bagliettoana* (A.Massal. & De Not.) Jatta - bri.terr-bri.cal (11) 830-1790 m.

**Bacidia beckhausii* Körb. - cor (Pav) (1) 1500 m.

**Bacidia circumspecta* (Nyl. *ex* Vain.) Malme - cor (Qf, Qr) (5) 800-1270 m.

**Bacidia friesiana* (Hepp) Körb. - cor (Jp, Qr) (3) 780-1450 m.

**Bacidia igniarii* (Nyl.) Oksner - cor (Qf, Qr) (6) 780-1270 m.

Bacidia rosella (Pers.) De Not. - cor (Ca, Qf, Qr) (8) 750-1350 m.

**Bacidia rubella* (Hoffm.) A.Massal. - cor (Bs, Ca, Jc, Pon, Qf, Qr) (11) 750-1500 m.

**Bacidia subincompta* (Nyl.) Arnold - cor (Hh) (1) 1350 m.

**Bagliettoa cazzae* (Zahlbr.) Vêzda & Poelt - cal (2) 700-1200 m.

**Bagliettoa parmigera* (J.Steiner) Vêzda & Poelt - cal (9) 830-1500 m.

**Bagliettoa parmigerella* (Zahlbr.) Vêzda & Poelt - cal (2) 800-1000 m.

**Bagliettoa steineri* (Kusan) Vêzda - cal (4) 760-890 m.

**Biatorella microhaema* Norman - cor (Qf) (1) 1270 m.

**Biatorella ochrophora* (Nyl.) Arnold - cor (Qf) (2) 800-1270 m.

**Bilimbia lobulata* (Sommerf.) Hafellner & Coppins - terr (15) 820-2028 m.

**Bilimbia sabuletorum* (Schreb.) Arnold - bri.cal-bri.terr-bri.cor (Pon, Qf, Qr) (14) 700-1930 m.

**Bryoria capillaris* (Ach.) Brodo & D.Hawksw. - cor (Pn) (1) 1350 m.

Bryoria fuscescens (Gyeln.) Brodo & D. Hawksw. - cor (Pn) (6) 1200-1790 m.

**Bryoria implexa* (Hoffm.) Brodo & D. Hawksw. - cor (Pn) (9) 1200-1790 m.

Buellia cedricola Werner - lig (Jo, Jp) (5) 850-1450 m.

**Buellia disciformis* (Fr.) Mudd - cor (Ia, Ph, Pn, Ppr, Qr) (8) 800-1850 m.

**Buellia epigaea* (Pers.) Tuck. - terr (2) 1740-1900 m.

Buellia griseovirens (Turner & Borrer ex Sm.) Almb. - cor (Au, Ea, Jo, Jp, Ph, Pn) (13) 800-1900 m.

Buellia iberica Giralt - cor (Pn) (5) 1200-1950 m.

**Buellia pulverulenta* (Anzi) Jatta - liq (*P. adscendens*) (1) 1270 m.

**Buellia triseptata* Nordin - cor (Ph, Pn) (5) 1100-1500 m.

Calicium abietinum Pers. - cor (Pn)-lig (Pn, Qf, Qr) (7) 950-1720 m.

Calicium glaucellum Ach. - cor (Pn)-lig (Qf) (7) 800-1400 m.

Calicium montanum Tibell -lig (Jo) (2) 950-1000 m.

Calicium salicinum Pers. - cor (Pn)-lig (Qf) (3) 1200-1350 m.

Calicium viride Pers. - cor (Pn) (7) 1200-1950 m.

**Caloplaca agardhiana* (A.Massal.) Clauzade & Cl. Roux - cal (12) 760-2028 m.

**Caloplaca adriatica* (Zahlbr.) Serv. - cal (2) 900-1300 m.

**Caloplaca alnetorum* Giralt, Nimis & Poelt - cor (Fa, Ca, Qf) (3) 830-1350 m.

**Caloplaca alociza* (A.Massal.) Mig. - cal (12) 890-1900 m.

**Caloplaca assigena* (J.Lahm ex Arnold) Dalla Torre & Sarnth. - cor (Pn (1) 1500 m.

**Caloplaca aurantia* (Pers.) Hellb. - cal (10) 760-1790 m.

**Caloplaca biatorina* (A. Massal.) J.Steiner - cal (3) 1450-1740 m.

Caloplaca cerina (Ehrh. ex Hedw.) Th.Fr. - cor (Au, Jo, Jp, Oe, Ph, Pn, Qf, Qr) (21) 800-1950 m.

**Caloplaca cerinella* (Nyl.) Flagey - cor (Pon, Pt) (2) 900-930 m.

**Caloplaca chalybaea* (Fr.) Müll. Arg. - cal (20) 800-2028 m.

**Caloplaca cirrochroa* (Ach.) Th.Fr. - cal (3) 1500-1790 m.

**Caloplaca citrina* (Hoffm.) Th.Fr. - cal (5) 760-1500 m.

**Caloplaca coronata* (Kremp. ex Körb.) J.Steiner - cal (10) 1150-1900 m.

Caloplaca erythrocarpa (Pers.) Zwackh - cal (13) 890-1790 m.

Caloplaca ferruginea (Huds.) Th.Fr. - cor (Ag, Am, Bs, Cm, Jo, Jp, Pav, Ph, Pn, Ppr, Pt, Qf, Qc, Qr, Ug) (23) 630-1790 m.

**Caloplaca flavescens* (Huds.) J.R.Laundon - cal (10) 800-1900 m.

Caloplaca flavorubescens (Huds.) J.R.Laundon - cor (Bs, Cm, Hh, Jc, Jp, Oe, Pav, Ph, Pn, Ppr, Qf, Qp, Qr, Ro) (20) 665-1790 m.

Caloplaca flavovirescens (Wulfen) Dalla Torre & Sarnth. - cal (2) 1150-1790 m.

**Caloplaca granulosa* (Müll.Arg.) Jatta - cal (2) 1430-1790 m.

**Caloplaca haematites* (Saint-Amans) Zwackh - cor (Cm, Pn) (2) 850-1500 m.

Caloplaca herbidella (Hue) H.Magn. - cor (Bs, Cm, Ia, Jc, Jo, Jp, Ph, Pn) (20) 800-1950 m.

Caloplaca holocarpa (Hoffm.) A.E.Wade - calcor (Bs, Cm, Ea, Jc, Jo, Oe, Ph, Ppr, Pon, Qr) (19) 760-1900 m.

**Caloplaca hungarica* H.Magn. - cor (Jo, Ph) (2) 800-1150 m.

**Caloplaca inconnexa* (Nyl.) Zahlbr. - cal (14) 800-1900 m.

**Caloplaca lactea* (A.Massal.) Zahlbr. - cal (9) 1180-2028 m.

**Caloplaca lacteoides* Navarro-Rosinés & Hladun - cal (4) 800-1430 m.

**Caloplaca marmorata* (Bagl.) Jatta. - cal (2) 1270-1400 m.

**Caloplaca obscurella* (J.Lahm ex Körb.) Th. Fr. - cor (Qp, Qr) (2) 780-1270 m.

**Caloplaca ochracea* (Schaer.) Flagey - cal (2) 760-800 m.

**Caloplaca phlogina* (Ach.) Glagey - cor (Pn, Pon) (6) 920-1500 m.

**Caloplaca polycarpa* (A.Massal.) Zahlbr. - cal (4) 1180-1940 m.

Caloplaca saxicola (Hoffm.) Nordin - cal (4) 1430-1790 m.

**Caloplaca stillicillorum* (Vahl) Lynge - bri.terr-bri.cor (3) 1200-1400 m.

**Caloplaca teicholyta* (Ach.) J.Steiner - cal (3) 1150-1900 m.

**Caloplaca variabilis* (Pers.) Müll. Arg. - cal (14) 800-1790 m.

**Caloplaca velana* (A.Massal.) Du Rietz - cal (10) 900-1900 m.

**Caloplaca xantholyta* (Nyl.) Jatta - cal (11) 850-1790 m.

Candelaria concolor (Dicks.) Stein. - cor (Oe, Ph) (3) 630-1000 m.

**Candelariella aurella* (Hoffm.) Zahlbr. - cal (13) 1180-1900 m.

Candelariella faginea Nimis, Poelt & Puntillo - cor (Ag) (1) 1700 m.

**Candelariella medians* (Nyl.) A. L. Sm. - cal (3) 1180-1430 m.

Candelariella viae-lacteae G.Thor & V.Wirth - cor (Jo, Oe) (2) 630-900 m.

Candelariella vitellina (Hoffm.) Müll. Arg. - cor (Bs, Cm, Jh, Jo, Jp, Ph, Pn, Ppr, Qf, Qr) (10) 800-1950 m.

Candelariella xanthostigma (Ach.) Lettau - cor (Cm, Jo, Jp, Ph, Pn, Pon, Pav, Pt, Qf, Qr) (16) 900-1790 m.

**Catapyrenium cinereum* (Pers.) Körb. - terr (2) 1740-1940 m.

Catapyrenium daedaleum (Kremp.) Stein - terr (2) 1740-1840 m.

**Catillaria chalybaea* (Borrer) A.Massal. - calcor (Bs, Jp)-lig (Jo) (5) 950-1500 m.

**Catillaria lenticularis* (Ach.) Th.Fr. - cal (7) 1230–1900 m.

**Catillaria minuta* (A.Massal.) Lettau - cal (1) 900 m.

Catillaria nigroclavata (Nyl.) Schuler - cor (Bs, Hh, Jc, Jo, Jp, Oe, Pn, Pon, Qr) (11) 630-1500 m.

Cetraria aculeata (Schreb.) Fr. - terr (3) 1270-1790 m.

Chaenotheca brunneola (Ach.) Müll. Arg. - cor (Pn) (2) 1350-1900 m.

Chaenotheca chrysocephala (Turner ex Ach.) Th.Fr. - cor (Pn, Ppr) (7) 850-1900 m.

Chaenotheca ferruginea (Turner & Borrer) Mig. - cor (Pn) (5) 1200-1900 m.

Chaenotheca furfuracea (L.) Tibell - cor (Pn) (7) 1200-1950 m.

Chaenotheca phaeocephala (Turner) Th.Fr. - cor (Pn) (5) 1200-1720 m.

Chaenotheca trichialis (Ach.) Th.Fr. - cor (Pn) (2) 1200-1350 m.

**Chaenothecopsis debilis* (Turner & Borrer ex Sm.) Tibell - cor (Pn) (1) 1450 m.

**Chromatochlamys muscorum* (Fr.) H.Mayrhofer & Poelt - bri.cal (4) 760-1350 m.

**Chrysothrix candelaris* (L.) J.R.Laundon - cor (Pn) (2) 1400-1790 m.

**Cladonia cervicornis* (Ach.) Flot. -terr (3) 780-1900 m.

Cladonia chlorophaea (Flörke ex Sommerf.) Spreng. - terr-cor (Bs, Jo, Ph, Pn, Qf) (18) 820-1700 m.

Cladonia coniocraea (Flörke) Spreng. - cor (Au, Pn, Ppr) (5) 800-1790 m.

Cladonia convoluta (Lam.) Anders - terr (13) 820-1900 m.

**Cladonia cyathomorpha* Stirt. ex Walt. Watson - cor (Pn, Qr) (2) 820-1200 m.

Cladonia fimbriata (L.) Fr. - cor (Au, Ph, Ppr, Pn, Qf, Qp) (19) 780-1900 m

**Cladonia glauca* Flörke - cor (Pn) (4) 1200-1450 m.

**Cladonia humilis* (With.) J.R.Laundon - terr-cor (Pn) (2) 1350-1790 m.

Cladonia macilenta Hoffm. - cor (Oe) (1) 1350 m.

Cladonia ochrochlora Flörke - cor (Pn) (4) 1200-1450 m.

Cladonia pocillum (Ach.) Grognot - terr (26) 780-1790 m.

Cladonia pyxidata (L.) Hoffm. - terr- cor (Jo, Ppr, Ro) (15) 800-1740 m.

**Cladonia ramulosa* (With.) J.R.Laundon - cor (Pn) (4) 1200-1450 m.

Cladonia rangiformis Hoffm. - terr (13) 1200-1790 m.

Cladonia squamosa Hoffm. - cor (Pn) (2) 1200-1350 m.

**Cladonia subrangiformis* Sandst. - terr (7) 1180-1900 m.

**Cladonia subulata* (L.) Weber ex F.H.Wigg. - cor (Pn) (1) 1450 m.

**Clauzadea immersa* (Weber) Hafellner & Bellem. - cal (5) 900-1900 m.

**Clauzadea metzleri* (Körb.) Clauzade & Cl.Roux ex D.Hawksw. - cal (4) 800-1450 m.

**Clauzadea monticola* (Schaer.) Hafellner & Bellem. - cal (12) 850-1900 m.

Collema auriforme (With.) Coppins & J.R.Laundon - cal (5) 850-1950 m.

**Collema callopismum* A.Massal. - cal (1) 1400 m.

Collema crispum (Huds.) Weber ex F.H.Wigg. - cal-terr (5) 850-1430 m.

Collema cristatum (L.) Weber ex F.H.Wigg. - cal (18) 830-1790 m.

Collema fasciculare (L.) Weber ex F.H.Wigg. - cor (Qf) (2) 800-1000 m.

Collema flaccidum (Ach.) Ach. - cor (Qf, Qr) (2) 830-900 m.

**Collema fragrans* (Sm.) Ach. - cor (Qf) (3) 800-1270 m.

Collema furfuraceum (Arnold) Du Rietz - cor (Ca, Pon, Pha, Ppr, Qf, Qr) (11) 780-1500 m.

Collema fuscovirens (With.) J.R.Laundon - cal-terr (10) 800-1900 m.

Collema ligerinum (Hy) Harm. - cor (Qr) (2) 900-1180 m.

**Collema limosum* (Ach.) Ach. - terr (2) 750-900.

Collema nigrescens (Huds.) DC. - cor (Qf, Qr) (3) 800-890 m.

Collema occultatum Bagl. - cor (Ag, Pav, Qr) (3) 900-1500 m.

Collema polycarpon Hoffm. - cal (4) 900-1950 m.

Collema subflaccidum Degel. - cor (Qf, Qr) (8) 750-1270 m.

Collema subnigrescens Degel. - cor (Pt, Qf, Qr) (10) 830-1500 m.

Collema tenax (Sw.) Ach. - cal-terr (15) 850-1900 m.

Collema undulatum Laurer ex Flot. - cal-terr (10) 820-1790 m.

Cyphelium inquinans (Sm.) Trevis. - cor (Pn) (4) 1200-1450 m.

Cyphelium tigillare (Ach.) Ach. - lig (Jo, Jp, Pn, Qf) (5) 950-1720 m.

Degelia atlantica (Degel.) P.M.Jørg. & P.James - cor (Qf, Qr) (4) 800-1000 m.

Degelia plumbea (Lightf.) P.M.Jørg. & P.James - cor (Ppr, Qf, Qr) (8) 750-1270 m.

**Dendriscocaulon umhausense* (Auersw.) Degel. - cor (Ppr, Qf, Qr) (6) 800-1270 m.

Dermatocarpon miniatum (L.) W.Mann - cal (4) 760-1900 m.

**Diploschistes muscorum* (Scop.) R.Sant. - bri.terr-bri.cal (10) 850-1740 m.

Diploschistes ocellatus (Vill.) Norm. - cal (9) 800-1400 m.

**Diplotomma epipolium* (Ach.) Arnold - cal (15) 800-1900 m.

**Diplotomma venustum* (Körb.) Körb.- cal (3) 900-1450 m.

Endocarpon pusillum Hedw. - terr (6) 820-1800 m.

Evernia prunastri (L.) Ach. - cor (Jo, Oe, Pt, Ph, Pn, Pav, Qf, Qp, Qr) (18) 820-1500 m.

**Farnoldia jurana* (Schaer.) Hertel - cal (3) 1500-1790 m.

Flavoparmelia caperata (L.) Hale - cor (Qf, Qr) (3) 780-1270 m.

Flavopunctelia flaventior (Stirt.) Hale - cor (Ph) (1) 1000 m.

**Fulgensia fulgida* (Nyl.) Szatala - terr (17) 850-1790 m.

**Fulgensia fulgens* (Sw.) Elenkin - terr (8) 1150-1790 m.

**Fulgensia schistidii* (Anzi) Poelt - bri.cal (14) 1180-1900 m.

Fuscopannaria ignobilis (Anzi) P.M.Jørg. - cor (Qf, Qr) (9) 820-1290 m.

Fuscopannaria mediterranea (Tav.) P.M.Jørg. - cor (Am, Au, Jc, Jo, Oe, Ph, Pn, Qf, Qr) (15) 665-1500 m.

Fuscopannaria olivacea (P.M.Jørg.) P.M.Jørg. - cor (Jo) (2) 820-1000 m.

Fuscopannaria saubinetii (Mont.) P.M.Jørg. - cor (Qf, Qr) (4) 800-1270 m.

**Gyalecta jenensis* (Batsch) Zahlbr. - cal (2) 1400-1690 m.

**Gyalecta truncigena* (Ach.) Hepp - cor (Qr) (8) 850 m.

Gyalecta ulmi (Sw.) Zahlbr. - cor (Qf, Qr) (6) 800-1270 m.

**Heteroplacidum imbricatum* (Nyl.) Breuss - terr (4) 850-1430 m.

**Hymenelia epulotica* (Ach.) Lutzoni - cal (2) 1600-1790 m.

**Hypocenomyce anthracophila* (Nyl.) P.James & Gotth.Schneid. - cor (Pn) (7) 1200-1900 m.

Hypocenomyce scalaris (Ach.) M.Choisy - cor (Pn, Ppr)-lig (Jo, Pn) (14) 800-1900 m.

Hypogymnia farinacea Zopf - cor (Ph, Pn, Ppr) (12) 820-1900 m.

Hypogymnia physodes (L.) Nyl. - cor (Ph, Pn, Ppr) (10) 820-1790 m.

Hypogymnia tubulosa (Schaer.) Hav. - cor (Au, Jc, Jo, Ph, Pn, Ppr, Qf, Qr) (12) 800-1850 m.

Imshaugia aleurites (Ach.) S.L.F.Meyer - cor (Pn) (1) 1200 m.

**Involucropyrenium waltheri* (Kremp.) Breuss - terr (2) 1840-1900 m.

Koerberia biformis A.Massal. - cor (Jo, Oe, Qf, Qr) (10) 630-1150 m.

**Lecania cyrtella* (Ach.) Th.Fr. - cor (Ca, Hh, Ia, Pon) (2) 1270-1350 m.

**Lecania erysibe* (Ach.) Mudd - cal (3) 900-1400 m.

Lecania fuscella (Schaer.) A.Massal. - cor (Pon) (2) 930-1270 m.

**Lecania koerberiana* J.Lahm - cor (Pn) (1) 1500 m.

**Lecania naegelii* (Hepp) Diederich & P.Boom - cor (Fa, Hh, Jc, Jp, Pav, Qr, Qp) (8) 830-1500 m.

**Lecania rabenhorstii* (Hepp) Arnold - cal (5) 800-1500 m.

**Lecanora agardhiana* Ach. - cal (2) 1430-1450 m.

**Lecanora albella* (Pers.) Ach. - cor (Qf, Qp) (2) 1270-1300 m.

**Lecanora albescens* (Hoffm.) Branth & Rostr. - cal (5) 760-1200 m.

**Lecanora allophana* Nyl. -cor (Hh, Pon) (2) 800-930 m.

**Lecanora argentata* (Ach.) Malme - cor (Pon) (2) 1270-1350 m.

**Lecanora campestris* (Schaer.) Hue - cal (1) 800 m.

Lecanora carpinea (L.) Vain. - cor (Ag, Am, Ca, Cm, Dl, Ia, Oe, Ppr, Pav, Qf, Qr) (10) 760-1500 m.

Lecanora chlarotera Nyl. - cor (Ag, Am, Bs, Ca, Cm, Jc, Jo, Oe, Ph, Ppr, Pon, Pt, Qr) (24) 760 m-1500 m.

Lecanora coniferarum Printzen - cor (Ppr) (1) 1230 m.

**Lecanora conizaeoides* Nyl. ex Crombie - cor (Pn) 1250-1300 m.

**Lecanora crenulata* Hook - cal (8) 800-1720 m.

Lecanora densa (Sliwa & Wetmore) Printzen - cor (Ppr) (1) 820 m.

**Lecanora dispersa* (Pers.) Sommerf. - cal (19) 800-1940 m.

**Lecanora expallens* Ach. - cor (Ph, Pn, Ppr) (6) 800-1500 m.

Lecanora hagenii (Ach.) Ach. - cor (Ag, Bs, Cm, Jo, Jp, Ph, Pn, Ppr, Pon, Qf) (17) 850-1900 m.

Lecanora horiza (Ach.) Linds. - cor (Bs, Jc, Jo, Jp, Pn, Ppr, Oe, Qc, Qf, Qr) (18) 760-1790 m.

**Lecanora hybocarpa* (Tuck.) Brodo - cor (Ca, Qf) (2) 800-1350 m.

Lecanora intumescens (Rebent.) Rabenh. - cor (Ag, Cm, Pn, Qf, Qr) (5) 760-1700 m.

Lecanora leptyrodes (Nyl) Degel. - cor (Qf, Qp) (30) 1270-1300 m.

Lecanora mughicola Nyl. - lig (Pn) (2) 1400-1700 m.

Lecanora muralis (Schreb.) Rabenh. - cal (18) 800-1940 m.

**Lecanora pruinosa* Chaub. - cal (2) 800-1200 m.

Lecanora pulicaris (Pers.) Ach. - cor (Ia, Jo) (2) 1350-1500 m.

**Lecanora saligna* (Schrad.) Zahlbr. - lig (Jp, Pn, Qf) (3) 1150-1270 m.

**Lecanora sambuci* (Pers.) Nyl. - cor (Qr) (3) 800-1000 m.

**Lecanora strobilina* (Spreng.) Kieff. - cor (Jp, Pn) (7) 1150-1500 m.

**Lecanora subcarpinea* Szatala - cor (Qf, Qr) (3) 800-1000 m.

**Lecanora symmicta* (Ach.) Ach. - cor (Ph, Ppr) (3) 800-1230 m.

Lecanora varia (Hoffm.) Ach. -lig (Jo, Jp, Pn) (4) 820-135 m.

**Lecanora xanthostoma* Cl.Roux ex Fröberg - cal (7) 870-1900 m.

**Lecidea botryosa* (Fr.) Th.Fr. - lig (Pn, Qf, Qr) (3) 950-1270 m.

Lecidea exigua Chaub. - cor (Cm, Jo, Qf) (2) 950-1270 m.

Lecidea holopolia (Tuck.) Zahlbr. (Syn.: *Mycobilimbia olivacea* Aragón, Sarrión & Hafellner) - cor (Pn) (5) 1200-1750 m.

**Lecidea hypopta* Ach. - cor (Pn) (3) 1200-1450 m.

**Lecidella carpathica* Körb. - cal (11) 1180-1940 m.

Lecidella elaeochroma (Ach.) M.Choisy - cor (Ag, Am, Au, Bs, Ca, Hh, Ia, Jc, Jh, Jo, Jp, Ph, Pon, Pn, Ppr, Pt, Qc, Qf, Qp, Qr) (21) 760-1950 m.

**Lecidella patavina* (A.Massal) Knoph & Leuckert - cal (2) 1180-1940 m.

**Lecidella pulveracea* (Flörke ex Th.Fr.) Sydow - cor (Bs, Ea, Hh, Jc, Ph, Pn) (10) 800-1790 m.

**Lecidella stigmatea* (Ach.) Hertel & Leuckert - cal (10) 800-1900 m.

Lepraria incana (L.) Ach. - bri.terr-bri.cal-bri.cor (Bs, Pn, Qr, Qf) (8) 820-1450 m.

Lepraria lobificans Nyl. - cor (Jo) (1) 830 m.

**Lepraria nivalis* J.R.Laundon - cal (5) 800-1790 m.

Leptogium brebissonii Mont. - cor (Qr) (3) 900-1350 m.

Leptogium burnetiae Dodge - cor (Qf) (1) 1270 m.

**Leptogium coralloideum* (Meyen & Flotow) Vainio - bri.cal (1) 900 m.

Leptogium cretaceum (Sm.) Nyl. - cal (1) 1180 m.

**Leptogium cyanescens* (Rabenh.) Körb. - cor (Pha, Qf) (2) 960-1270 m.

Leptogium diffractum Kremp. ex Körb. - cal (2) 1270-1350 m.

**Leptogium furfuraceum* (Harm.) Sierk - cor (Bs, Qf, Qr) (5) 800-1100 m.

Leptogium gelatinosum (With.) J.R.Laundon - bri.cal (6) 820-1950 m.

Leptogium imbricatum P.M.Jørg. - terr (1) 1200 m.

Leptogium intermedium (Arnold) Arnold - cor (Qf) (1) 1270 m.

Leptogium lichenoides (L.) Zahlbr. - bri.cal-bri.terr-bri.cor-cor (Oe, Pon, Pt, Qf, Qr, Jp)(26) 750-1790 m.

Leptogium massiliense Nyl. - cal (2) 820-890 m.

Leptogium microphylloides Nyl. - cor (Qr) (1) 800 m.

Leptogium quercicola Otálora, Aragón, I.Martínez & Molina - cor (Qf, Qr) (5) 780-1270 m.

Leptogium saturninum (Dicks.) Nyl. - Qf, Qr (7) 750-1300 m.

Leptogium schraderi (Bernh.) Nyl. - terr (3) 870-1270 m.

Leptogium subaridum P.M.Jørg. & Goward - cor (Qf, Qr) (3) 850-1270 m.

**Leptogium subtile* (Schrad.) Torss. - cor (Qf, Qr) (3) 850-1000 m.

**Leptogium tenuissimum* (Dicks.) Körb. - cor (Au, Qf) (3) 950-1350 m.

**Leptogium teretiusculum* (Wallr.) Arnold - cor (Oe, Pon, Qf, Qr) (8) 780-1350 m.

**Lichinella algerica* (J.Steiner) P.Moreno & Egea - cal (2) 760-800 m.

Lobaria pulmonaria (L.) Hoffm. - cor (Au, Qf, Qr) (8) 800-1270 m.

Lobarina scrobiculata (Scop.) Cromb. - cor (Ppr, Qf, Qr) (4) 750-1000 m.

**Lobothallia radiosa* (Hoffm.) Hafellner- cal (16) 830-1900 m.

**Macentina dictyospora* Orange - cor (Qi) (2) 800-1150 m.

Megaspora verrucosa (Ach.) Hafellner & V.Wirth - bri.terr-cor (Bs, Cm, Jh, Jo, Jp, Pn, Qf, Qr) (15) 760-1900 m.

Melanelia elegantula (Zahlbr.) Essl. - cor (Ia, Jc, Pn, Ppr, Qr) (4) 1000-1500 m.

Melanelia exasperata (De Not.) Essl. - cor (Ag, Am, Jc, Oe, Qc, Qf, Qr) (9) 760-1700 m.

Melanelia exasperatula (Nyl.) Essl. - cor (Jc, Ph, Qf) (3) 1000-1500 m.

Melanelia fuliginosa (Fr. ex Duby) Essl. - cor (Au, Ph, Pn, Ppr, Qf, Qr) (12) 780-1500 m.

Melanelia glabra (Schaer.) Essl. - cor (Jp, Oe, Ph, Pt, Qf, Qr) (17) 665-1500 m.

Melanelia laciniatula (Flagey ex H. Olivier) Essl. - cor (Jc, Jo, Pn, Ppr, Qf) (4) 820-1500 m.

Melanelia subaurifera (Nyl.) Essl. - cor (Bs, Oe, Qf) (5) 665-1100 m.

**Melaspilea proximella* (Nyl.) Nyl. - cor (Jc, Jp) (2) 1450-1500 m.

**Melaspilea urceolata* (Fée) Almb. - cor (Qf, Qr) (2) 760-1270 m.

**Micarea denigrata* (Fr.) Hedl. - cor (Pn) (3) 1270-1900 m.

**Micarea misella* (Nyl.) Hedl. - lig (Ph, Qr) (1) 800-950 m.

**Micarea prasina* Fr. - cor (Pn, Ppr)-lig (Pn) (8) 1200-1790 m.

Mycobilimbia berengeriana (A.Massal.) Hafellner & V.Wirth - bri.cal-bri.terr-bri.cor (Au, Qf, Qr) (4) 800-1350 m.

Mycobilimbia hypnorum (Lib.) Kalb & Hafellner - bri.cal-bri.terr (6) 830-1530 m.

**Mycobilimbia lurida* (Ach.) Hafellner & Türk - cal-terr (4) 900-1430 m.

Mycobilimbia parvilobulosa Sarrión, Aragón & Hafellner - cor.bri (Qr) (3) 750-900 m.

Mycocalicium subtile (Pers.) Szatala - cor (Pn, Jo)-lig (Jo, Pn, Qf) (7) 1000-1720 m.

**Naetrocymbe punctiformis* (Pers.) R.C.Harris - cor (Ca, Dl, Pon) (2) 1270-1350 m.

Nephroma laevigatum Ach. - cor (Au, Pha, Qf, Qr) (10) 750-1270 m.

**Normandina pulchella* (Borrer) Nyl. - cor (Pha, Qf, Qr) (6) 820-1000 m.

**Ochrolechia alboflavescens* (Wulfen) Zahlbr. - cor (Jp, Pn, Ppr, Qf) (4) 1270-1500 m.

**Ochrolechia dalmatica* (Erichsen) Boqueras - cor (Jc, Pn) (2) 1400-1500 m.

**Ochrolechia pallescens* (L.) A.Massal. - cor (Pn, Qp) (3) 850-1900 m.

**Ochrolechia subviridis* (Höeg.) Erichsen - cor (Qr) (2) 900-1000 m.

Ochrolechia szatalaensis Verseghy - cor (Pn) (2) 1250-1350 m.

Ochrolechia turneri (Sm.) Hasselrot - cor (Pn, Ppr) (9) 1250-1900 m.

**Opegrapha calcarea* Sm. - cal (2) 900-1180 m.

**Opegrapha varia* Pers. - cor (Qf) (2) 850-1270 m.

Pannaria conoplea (Ach.) Bory - cor (Qf, Qr) (4) 800-900 m.

Pannaria rubiginosa (Ach.) Bory - cor (Qr) (4) 800-900 m

Parmelia saxatilis (L.) Ach. - cor (Jp, Ph, Pn, Ppr, Qr)-lig (Jo, Pn) (17) 780-1790 m.

Parmelia submontana Nádv. ex Hale - cor (Ia, Jc, Ph, Ppr, Qf, Qr) (11) 780-1500 m.

Parmelia sulcata Taylor - cor (Jc, Ph, Pn, Ppr, Pav, Qf, Qr) (10) 780-1500 m.

Parmeliella testacea P.M.Jørg. - cor (Qr) (28) 900 m.

Parmeliella triptophylla (Ach.) Müll. Arg. - cor (Pn, Pla) (1) 1350 m.

Parmelina pastillifera (Harm.) Hale - (Pav, Pla) (2) 1350-1500 m.

**Parmelina quercina* (Willd.) Hale - cor (Am, Ia, Oe, Pt, Pla, Qf, Qr) (9) 665-1350 m.

Parmelina tiliacea (Hoffm.) Hale - cor (Bs, Ia, Jc, Jo, Jp, Oe, Ph, Pn, Ppr, Pon, Pt, Qf, Qp, Qr) (23) 665-1500 m.

Parmeliopsis ambigua (Wulfen) Nyl. - cor (Pn) (5) 1350-1900 m.

**Parmotrema perlatum* (Huds.) M.Choisy - cor (Qr) (1) 780 m.

**Peccania coralloides* (A.Massal.) A.Massal. - cal (5) 760-1150 m.

Peltigera canina (L.) Willd. - terr (4) 820-1350 m.

Peltigera collina (Ach.) Schrad. - cor (Qf, Qr) (9) 750-1270 m.

Peltigera horizontalis (Huds.) Baumg. - bri.cal-bri.cor (Qf) (2) 1270-1350 m.

Peltigera membranacea (Ach.) Nyl. - terr (1) 1900 m.

Peltigera monticola Vitik. - cal (7) 1450-1900 m.

Peltigera neckeri Hepp ex Müll. Arg. - terr-bri.cor (Ca, Qr) (10) 780-1400 m.

Peltigera ponojensis Gyeln. - terr (3) 890-1400 m.

Peltigera praetextata (Flörke ex Sommerf.) Zopf - terr (12) 780-1900 m.

Peltigera rufescens (Weiss) Humb. - terr (19) 800-1790 m.

Pertusaria albescens (Huds.) M.Choisy & Werner - cor (Jp, Pn, Qf, Qr) (18) 760-1950 m.

Pertusaria amara (Ach.) Nyl. - cor (Bs, Pn, Qr) (8) 760-1790 m.

**Pertusaria coccodes* (Ach.) Nyl. - cor (Bs, Qf, Qr) (6) 800-1450 m.

Pertusaria coronata (Ach.) Th.Fr. - cor (Jo) (1) 1000 m.

Pertusaria flavida (DC.) J.R.Laundon - Ph, Qr (4) 760-1000 m.

Pertusaria hemisphaerica (Flörke) Erichsen - cor (Jo, Jp, Oe, Pn, Qp, Qr) (6) 760-1450 m.

**Pertusaria leucostoma* A.Massal. - cor (Ppr) (28) 1000 m.

**Pertusaria ophthalmiza* (Nyl.) Nyl. - cor (Pn) (9) 850-1900 m.

Pertusaria paramerae Crespo & Vìzda - lig (Jo, Pn) (6) 900-1950 m.

**Pertusaria pertusa* (Weigel) Tuck. - cor (Qf, Qr) (4) 760-1270 m.

**Petractis clausa* (Hoffm.) Kremp. - cal (2) 830-1180 m.

**Phaeophyscia ciliata* (Hoffm.) Moberg - cor (Pon, Qr) (2) 930-1120 m.

**Phaeophyscia hirsuta* (Mereschk.) Essl. - cor (Oe, Qr) (2) 630-780 m.

**Phaeophyscia insignis* (Mereschk.) Moberg - cor (Pon, Qf) (2) 800-1500 m.

Phaeophyscia orbicularis (Neck.) Moberg - cal-cor (Bs, Ca, Jp, Oe, Pt, Pav, Qf, Qr) (26) 630-1940 m.

**Phlyctis agelaea* (Ach.) Flot. - cor (Ca) (1) 1350 m.

Phlyctis argena (Spreng.) Flot. - cor (Am, Au, Bs, Jc, Jo, Ph, Pn, Qf, Qp, Qr) (19) 665-1500 m.

Physcia adscendens (Fr.) H.Olivier - cal-cor (Bs, Fa, Jo, Jp, Oe, Ph, Pn, Pon, Pav, Qc, Qr) (17) 780-1940 m.

Physcia aipolia (Ehrh. ex Humb.) Fürnr. - cor (Ca, Oe, Ph, Pon, Pt, Pav, Qf, Qr) (13) 665-1500 m.

Physcia biziana (A.Massal.) Zahlbr. - cor (Ag, Cm, Jo, Jp, Ph, Qr) (6) 950-1700 m.

Physcia caesia (Hoffm.) Fürnr. - cal (3) 1430-1900 m.

Physcia clementei (Turner) Maas Geest. - cal (1) 1940 m.

**Physcia dubia* (Hoffm.) Lettau - cal (2) 1150-1180 m.

Physcia semipinnata (J.F.Gmelin) Moberg - cor (Bs, Cm, Jc, Jo, Jp, Pav, Ph, Pon, Ppr, Pt, Qc, Qf, Qr) (20) 780-1500 m.

Physcia stellaris (L.) Nyl. - cor (Ag, Bs, Ia, Jp, Ph) (9) 800-1450 m.

Physcia tenella (Scop.) DC. - cal-cor (Jo, Oe, Ph, Pn) (10) 665-1740 m.

**Physconia detersa* (Nyl.) Poelt - cor (Pt) (1) 900 m.

Physconia distorta (With.) J.R.Laundon - Jp, Qf, Qr (9) 750-1270 m.

Physconia enteroxantha (Nyl.) Poelt - cor (Jc, Jp, Oe, Ph, Pon, Qp, Qr) (8) 665-1500 m.

Physconia perisidiosa (Erichsen) Moberg - cal-cor (Jp, Qf, Qp) (8) 1000-1790 m.

**Physconia subpulverulenta* (Szatala) Poelt - cor (Ppn, Qf) (2) 1270-1500 m.

Physconia venusta (Ach.) Poelt - cor (Oe, Ph, Pon, Qf, Qr) (7) 800-1500 m.

Placidiopsis tenella (Nyl.) Zahlbr. - terr (3) 900-1000 m.

**Placidium adami-borosi* Szatala - terr (2) 1200-1270 m.

** Placidium lacinulatum* (Ach.) Breuss - terr (4) 900-1690 m.

**Placidium lachneum* (Ach.) de Lesd. - terr (6) 850-1700 m.

** Placidium pilosellum* (Breuss) Breuss - terr (7) 760-1780 m.

** Placidium rufescens* (Ach.) A. Massal.- terr (3) 850-1780 m.

**Placocarpus schaereri* (Fr.) Breuss - cal (11) 900-2028 m.

Placidium squamulosum (Ach.) Breuss - terr (9) 800-1900 m.

**Placolecis opaca* (Fr.) Hafellner - cal (8) 800-1270 m.

**Placopyrenium subtrachyticum* (de Lesd.) Breuss - cal (1) 1600 m.

**Placynthiella icmalea* (Ach.) Coppins & P.James - cor (Pn)-lig (Jp, Pn, Qf, Qr) (6) 830-1400 m.

**Placynthiella uliginosa* (Schrad.) Coppins & P.James - cor (Pn) (1) 1400 m.

**Placynthium asperellum* (Ach.) Trevis. - cal (3) 1270-1600 m.

**Placynthium filiforme* (Garov.) M.Choisy - cal (1) 1150 m.

**Placynthium hungaricum* Gyeln. - cal (2) 900-1430 m.

**Placynthium nigrum* (Huds.) Gray - cal (23) 800-1950 m.

**Placynthium subradiatum* (Nyl.) Arnold - cal (10) 900-1900 m.

Placynthium tremniacum (A.Massal) Jatta - cal (7) 830-1900 m.

Platismatia glauca (L.) W.L.Culb. & C.F.Culb. - cor (Ph, Pn, Ppr) (18) 665-1900 m.

Pleurosticta acetabulum (Neck.) Elix & Lumbsch - cor (Ia, Jc, Qf, Qp, Qr) (6) 830-1500 m.

**Polysporina simplex* (Davies) Vìzda - cal (3) 1450-1900 m.

**Polysporina urceolata* (Anzi) Brodo - cal (2) 1600-2028 m.

**Porina aenea* (Wallr.) Zahlbr. - cor (Ca, Ia) (1) 1350 m.

**Protoblastenia calva* (Dicks.) Zahlbr. - cal (12) 800-1790 m.

**Protoblastenia incrustans* (DC.) J.Steiner - cal (6) 1270-2028 m.

**Protoblastenia rupestris* (Scop.) J.Steiner - cal (7) 890-1900 m.

**Protoparmelia oleagina* (Harm.) Coppins - lig (Jp) (2) 1200-1450 m.

Pseudevernia furfuracea (L.) Zopf - cor (Bs, Jc, Jp, Ph, Pn, Ppr, Qr) (18) 780-1900 m.

Psora decipiens (Hedw.) Hoffm. - terr (21) 820-1900 m.

**Psora globifera* (Ach.) A.Massal. - terr (5) 1270-1900 m.

Psora testacea (Hoffm.) Ach. - cal (12) 820-1900 m.

Psora vallesiaca (Schaer.) Timdal - terr (17) 820-1790 m.

Psoroglaena stigonemoides (Orange) Henssen - cor (Qf) (2) 800-1270 m.

**Psorotrichia diffracta* (Nyl.) Forssell - cal (1) 760 m.

**Psorotrichia frustulosa* Anzi - cal (1) 900 m.

**Psorotrichia schaereri* (A.Massal.) Arnold - cal (5) 800-1180 m.

**Pterigyopsis affinis* (A.Massal.) Henssen - cal (3) 800-900 m.

Punctelia borreri (Sm.) Krog - cor (Qr) (3) 780-1270 m.

Punctelia subrudecta (Nyl.) Krog - lig (Qf) (1) 1250 m.

Pyrrhospora elabens (Fr.) Hafellner - lig (Jo) (2) 900-950 m.

**Pyrrhospora quernea* (Dicks.) Körb. - cor (Ph, Pn, Ppr) (7) 800-1450.

Ramalina calicaris (L.) Fr. - cor (Qf, Qr) (4) 750-1270 m.

Ramalina farinacea (L.) Ach. - cor (Am, Ia, Oe, Pt, Qf, Qp, Qr) (15) 665-1500 m.

Ramalina fastigiata (Pers.) Ach. - cor (Qf, Qr) (5) 750-1500 m.

Ramalina fraxinea (L.) Ach. - cor (Ca, Ia, Pt, Qf, Qr) (9) 780-1790 m.

Rinodina anomala (Zahlbr.) H.Mayrhofer & Giralt - cor (Jo)-lig (Jo) (2) 950-1150 m.

Rinodina archaea (Ach.) Arnold - cor (Ph, Pn) (9) 800-1900 m.

**Rinodina bischoffii* (Hepp) A.Massal. - cal (16) 1150-1900 m.

**Rinodina capensis* Hampe - cor (Cm, Qf, Qr) (4) 800-1270 m.

**Rinodina castanomela* (Nyl.) Arnold - cal (24) 1400 m.

**Rinodina colobina* (Ach.) Th.Fr. - cor (Jp, Oe) (3) 665-1450 m.

Rinodina dalmatica Zahlbr. - lig (Qf, Ph, Pn) (7) 800-1790 m.

**Rinodina dubyana* (Hepp) J.Steiner - cal (4) 1400-2028 m.

Rinodina exigua (Ach.) Gray - cor (Ag, Jc, Jo, Qc, Qf) (7) 780-1700 m.

Rinodina furfuracea H.Magn. - cor (Jo) (1) 850 m.

**Rinodina gennarii* Bagl. - cal (2) 1430-1450 m.

**Rinodina guzzinii* Jatta - cal (1) 1740 m.

**Rinodina immersa* (Körb.) Zahlbr. - cal (12) 890-1790 m.

**Rinodina lecanorina* (A.Massal.) A.Massal. - cal (9) 800-1740 m.

Rinodina oleae Bagl. - cor (Bs, Jo, Jp) (3) 1000-1200 m.

Rinodina plana H. Magn. - cor (Pon) (2) 930-1270 m.

Rinodina pyrina (Ach.) Arnold - cor (Ag, Am, Ph, Pn, Qf, Qr) (9) 760-1700 m.

Rinodina septentrionalis Malme - cor (Jc, Ph, Pn, Qf) (8) 800-1500 m.

Rinodina sophodes (Ach.) A.Massal. - cor (Ag, Jo, Pon, Qc, Qf, Qr) (9) 760-1700 m.

**Rinodinella controversa* (A.Massal.) H.Mayrhofer & Poelt - cal (4) 900-1790 m.

**Rinodinella dubyanoides* (Hepp) H.Mayrhofer & Poelt - cal (5) 1270-1900 m.

**Sagiolechia protuberans* (Ach.) A.Massal. - cal (2) 1500-1740 m.

**Sarcogyne privigna* (Ach.) A.Massal. - cal (3) 850-1500 m.

**Sarcogyne regularis* Körb. - cal (20) 850-1900 m.

Sclerophora nivea (Hoffm.) Tibell - cor (Qf) (1) 1270 m.

**Scoliciosporum sarothamni* (Vain.) Vìzda - cor (Ia) (1) 1350 m.

**Scoliciosporum umbrinum* (Ach.) Arnold - cor (Am, Ca, Hh, Pon) (3) 930–1350 m.

Seirophora contortuplicata (Ach.) Frödén - cal (2) 1940-2028 m.

**Solenopsora candicans* (Dicks.) J.Steiner - cal (6) 800-1800 m.

**Solenopsora olivacea* (Fr.) Kilias - cal (3) 830-1270 m.

Solorina saccata (L.) Ach. - terr (11) 800-1790 m.

Squamarina cartilaginea (With.) P.James - cal-terr (20) 800-1790 m.

Squamarina gypsacea (Sm.) Poelt - cal (1) 1450 m.

Squamarina lentigera (Weber) Poelt - terr (3) 1150-1800 m.

**Squamarina oleosa* (Zahlbr.) Poelt - cal (3) 830-1150 m.

Staurolemma omphalarioides (Anzi) P.M.Jørg. & Henssen - cor (Qf, Qr) (3) 750-900 m.

**Staurothele caesia* (Arnold) Arnold - cal (1) 1430 m.

**Staurothele hymenogonia* (Nyl.) Th.Fr. - cal (6) 1270-1900 m.

**Staurothele immersa* (A.Massal.) Dalla Torre & Sarnth - cal (3) 1270-1450 m.

**Staurothele orbicularis* (A.Massal.) Th.Fr. - cal (1) 1530 m.

**Strangospora deplanata* (Almq.) Clauzade & Cl.Roux - cor (Qf) (2) 800-1270 m.

**Strangospora moriformis* (Ach.) Stein. - cor (Qf) (1) 1270 m.

**Strigula affinis* (A.Massal) R.C.Harris - cor (Pon) (1) 1350 m.

**Synalissa symphorea* (Ach.) Nyl. - terr (8) 820-1900 m.

Tephromela atra (Huds.) Hafellner - cor (Ia, Pn, Qf, Qr) (7) 800-1450 m.

**Thelidium decipiens* (Nyl.) Kremp. - cal (4) 1400-1900 m.

**Thelidium incavatum* Mudd - cal (3) 930-1900 m.

**Thelochroa montinii* A.Massal. - cal (4) 1150-1900 m.

**Thyrea girardi* (Dur. & Mont.) Bagl. & Car. - cal (1) 760 m.

**Toninia albilabra* (Dufour) H.Olivier - cal-terr (4) 1150-1400 m.

**Toninia aromatica* (Sm.) A.Massal. - cal-terr (1) 1200 m.

Toninia candida (Weber) Th.Fr. - cal (11) 820-1790 m.

Toninia diffracta (A.Massal.) Zahlbr. - cal (9) 1150-1900 m.

**Toninia episema* (Nyl.) Timdal - liq (*C. variabilis*) (1) 1300 m.

Toninia opuntioides (Vill.) Timdal - terr (10) 890-1900 m.

**Toninia plumbina* (Anzi) Hafellner & Timdal - liq (*D. plumbea*) (1) 830-890 m.

Toninia sedifolia (Scop.) Timdal - terr (20) 820-1740 m.

**Toninia taurica* (Szatala) Oksner - terr (9) 820-1900 m.

**Toninia toniniana* (A.Massal.) Zahlbr. - terr (2) 900-1270 m.

**Toninia tristis* (Th.Fr.) Th.Fr. - terr (3) 1150-1300 m.

Toninia tumidula (Sm.) Zahlbr. - cal (1) 1400 m.

Trapeliopsis flexuosa (Fr.) Coppins & P.James - cor (Ph, Pn, Ppr)-lig (Jp, Pn, Qf) (13) 830-1790 m.

**Trapeliopsis gelatinosa* (Flörke) Coppins & P.James - cor (Ph)-lig (Qf) (2) 800-1100 m.

**Trapeliopsis granulosa* (Hoffm.) Lumbsch - cor (Pn) (2) 1400-1900 m.

Tuckermannopsis chlorophylla (Willd.) Hale - cor (Pn) (3) 1200-1450 m.

**Usnea glabrescens* (Nyl. ex Vain.) Vain. - cor (Ph, Pn, Ppr, Qr) (6) 820-1270 m.

Usnea hirta (L.) Weber ex F.H.Wigg. - cor (Pn) (7) 830-1790 m.

Usnea subfloridana Stirt. - cor (Pn, Qf) (3) 830-1400 m.

Usnea wasmuthii Räsänen - cor (Qf, Qr) (5) 780-1270 m.

**Verrucaria beltraminiana* (A.Massal.) Trevis. - cal (2) 800-1150 m.

**Verrucaria caerulea* DC. - cal (3) 1230-1700 m.

**Verrucaria canella* Nyl. - liq (*A. calcarea*) (4) 1180-1500 m.

Verrucaria calciseda auct. - cal (19) 800-1900 m.

**Verrucaria cinereorufa* Schaer. - cal (3) 890-1230 m.

**Verrucaria cinereoviridescens* Zschacke - cal (2) 890-1530 m.

**Verrucaria cyanea* A.Massal. - cal (1) 1180 m.

**Verrucaria dufourii* DC. - cal (6) 930-1700 m.

**Verrucaria fuscella* (Turner) Winch - cal (3) 1230-1530 m.

**Verrucaria fuscula* Nyl. - liq (*A. calcarea*) (3) 1270-1430 m.

**Verrucaria hochstetteri* Fr. - cal (4) 1000-1600 m.

**Verrucaria lecideoides* (A.Massal.) Trevis. - cal (16) 800-1900 m.

**Verrucaria macrostoma* Duf. ex DC. - cal (1) 1530 m.

**Verrucaria marmorea* (Scop.) Arnold - cal (14) 1000-1900 m.

**Verrucaria muralis* Ach. - cal (4) 800-1450 m.

**Verrucaria nigrescens* Pers. - cal (19) 890-1900 m.

**Verrucaria ochrostoma* (Borrer) Trevis. - cal (1) 1270 m.

**Verrucaria pinguicula* A.Massal. - cal (3) 890-1150 m.

**Verrucaria polysticha* Borrer - cal (2) 1200-1450 m.

Verrucaria sorbinea Breuss. - cor (Qf, Qr) (2) 780-1000 m.

**Verrucaria transiliensis* Arnold - cal (1) 890 m.

**Verrucaria tristis* (A.Massal.) Kremp. - cal (2) 800-1200 m.

**Verrucaria viridula* (Schrad.) Ach. - cal (2) 800-900 m.

Waynea adscendens Rico - cor (Qf, Qr) (6) 780-1270 m.

Xanthoria calcicola Oksner - cal (3) 1790-2028 m.

**Xanthoria candelaria* (L.) Th.Fr. - cor (Pon) (2) 930-1270 m.

Xanthoria elegans (Link) Th.Fr. - cal (2) 1790-1940 m.

Xanthoria parietina (L.) Th.Fr. - cal- cor (Bs, Cm, Oe, Ph, Pon, Pt, Pav, Qc, Qf, Qr) (17) 630-1500 m.

**Xylographa parallela* (Ach.: Fr.) Behler & Desberger - lig (Pn) (1) 1850 m.

Xyloschistes platytropa (Nyl.) Vain. - lig (Jo, Jp) (4) 950-1450 m.

Zahlbrucknerella calcarea (Herre) Herre - cal (3) 830-1430 m.

Conclusions

General remarks

A total of 125 genera and 497 species are reported from the "Cazorla, Segura and Las Villas" Biosphere Reserve. I*nvolucropyrenium waltheri, Placynthium asperellum, Strangospora deplanata, Verrucaria cinereoviridescens* and *V. polysticha* are cited for the first time in Spain, and 267 lichen taxa are new to the lichen flora of Jaén province. With the present data, the distributional rank of several species, such as *Agonimia allobata, A. octospora, Aspicilia lignicola, Bacidia absistens, B. subincompta, Bryoria capillaris, Calicium montanum, Caloplaca adriatica, Caloplaca assigena, Catapyrenium daedaleum, Lecanora coniferarum, L. densa, Lecidea hypopta, Leptogium burnetiae, Leptogium cretaceum, L. imbricatum, L. microphylloides, L. subaridum, Macentina dictyospora, Melaspilea urceolata, Placynthium hungaricum, Psora globifera, Psoroglaena stigonemoides, Protoparmelia oleagina, Psorotrichia frustulosa, Rinodina castanomela, R. dalmatica, R. furfuracea, Verrucaria aspiciliicola, V. sorbinea* and *V. transiliensis* extend to southern Spain.

The genera with the highest number of species were *Caloplaca* (37), *Lecanora* (30) and *Verrucaria* (23), all of them with a cosmopolitan range. Crustose species (such as the genera *Aspicilia, Bacidia, Caloplaca, Lecanora, Rinodina* and *Verrucaria*) were the most abundant life form of the flora (60%). Moreover, similar percentages between epiphytic and saxicolous lichens were present. The foliose genera represented the 21% of the species, members such as *Collema, Melanelia, Parmelia, Physcia* or *Physconia* were present. About 77% of these species were corticolous, the rest grew on soils and exposed rocks. Mostly fruticulose genera (*Bryoria, Ramalina, Usnea*) were found on bark and constituted the 4% of the total taxa. *Cladonia* sp. pl. accounted for the 3% of specimens collected. Squamulose species (*Catapyrenium, Psora, Toninia*) comprised 9%, mostly of them growing on soils. "Pin" lichens (*Calicium*, *Chaenotheca*, *Chaenothecopsis*, *Cyphelium*, *Mycocalicium*, *Sclerophora*) were the 3% of the total and were growing on bark of pine or lignum, most of them inside humid pine black forests. Saxicolous lichens were 32%, terricolous 14%, epiphytic 53% (corticolous 49% and lignicolous 5%) and lichenicolous 1%.

Lichen diversity

Lichen taxa with cyanobaterial were special abundant in the studied area (80 species). The presence of well-preserved forests and, the high annual rainfall rate (Pm > 1000 mm), together with a semioceanic temperature range index (Rivas-

Martínez 1993) explain this fact. These conditions allow a moisture-leaden in summer in same valleys and ravines. These singular areas contain the highest number of species (240 to 290 per km^2), in contrast with more xeric hillsides covered by Mediterranean shrublands (*Lavandula latifolia, Thymus mastichina* and *Rosmarinus officinalis*), with 30 to 50 species per km^2. Three habit are particularly richness in cyanolichens: A) some of the best preserved *Quercus faginea* and *Q. rotundifolia* stands located in steep ravines crossed by Guadalquivir, Borosa and Aguamulas rivers. These old-growth stands allow the existence of a great number of lichens, such as *Degelia atlantica, D. plumbea, Fuscopannaria ignobilis, F. saubinetii, F. mediterranea, Koerberia biformis, Lobaria pulmonaria, Lobarina scrobiculata, Nephroma laevigatum, Normandina pulchella, Pannaria conoplea, P. rubiginosa, Parmeliella testacea* and *Staurolemma omphalarioides*. In this "nemoral environment" the genera *Collema* (18 species) and *Leptogium* (16 species) were locally abundant. B) Vertical outcrops and fissures of calcareous rocks where the water remains for long time after rainfall. In this habit, cyanophyllous lichens (Lichinaceae) such as *Anema decipiens, A. nodulosum, A. notarisii, A. nummularium, Lichinella algerica, Peccania coralloides, Psorotrichia diffracta, P. frustulosa, P. schaereri, Pterigyopsis affinis* and *Thyrea girardi* were common. In contrast, in southern Spain their optimal niches are sunny and semiarid conditions (Moreno & Egea 1991). However, in the studied area, the species occurs in subhumid to humid conditions of the meso- to supramediterranean belts. C) Shaded vertical and slope surface of calcareous blocks in humid areas inside forests. Some species in this habit were: *Leptogium cretaceum, L. diffractum, L. massiliense, Placynthium asperellum, P. hungaricum, P. nigrum, P. tremniacum* and *Zahlbrucknerella calcarea*.

EPIPHYTIC LICHENS - the most characteristic species in dense forests stands (*Quercus faginea, Q. rotundifolia*) were cyanolichens (see list of species). Besides, *Agonimia allobata, A. octospora, A. opuntiella, Macentina dictyospora, Psoroglaena stigonemoides* and *Verrucaria sorbinea* were most frequent among mosses or on rough-bark found below mosses. In old-growth trees (up to 300 years old), were also frequent crustose lichens growing on fissure bark, such as *Bacidia circumspecta, B. igniarii, Biatorella microhaema, B. ochrophora, Melaspilea urceolata, Sclerophora nivea, Strangospora deplanata* and *S. moriformis*.

In contrast, epiphytic lichens diversity in open oak-holm stands which are located in stony hillsides in drier conditions, were less abundant than in dense forest. In adition, cyanolichens were absent or only few species with small thalli appear (*Collema occultatum, Leptogium subtile, L. teretiusculum*). (Table 2). Crustose lichens such as the genera *Buellia, Caloplaca, Lecanora, Rinodina* and foliose genera (*Physcia, Physconia and Xanthoria*) were common under these conditions.

Pine forests were a special habit for epiphytic lichens. Supramediterranean *Pinus nigra* forests cover vast areas of potentially *Quercus faginea* forests. The pine forests with a dense cover are located in humid valleys and the tree canopy layer is dominated by *P. nigra, Acer granatense, A. monspessulanum, Corylus avellana* and *Ilex aquifolium*. The microclimatic conditions allow the existence of a great epiphytic diversity, up to 90 of the total species were collected on bark or lignum of *Pinus nigra*. The mazaediate lichens and calicioid fungi (*Calicium, Chaenotheca, Cyphelium*

Table 2: Comparative epiphytic lichen diversity on fagaceous forests stands.

Situation	Ravines			Valleys			Stony hillsides							
Localities	28	38	39	6	8	30	13	20	23	54	26	31	40	43
Altitude (m)	900	850	1000	900	870	1270	800	1150	1100	760	1350	1300	1300	1500
Forets dominate	Qr	Qr	Qr	Qf	Qf	Qf	Qi	Qi	Qi	Qi	Qi	Qi	Qi	Qi
N° epiphytes	143	133	112	113	110	138	39	37	48	69	34	37	29	41
N° epiphytic cyanolichens	32	27	25	20	21	28	1	1	2	6	0	1	0	2

and *Mycocalicium*), *Bryoria* sp. pl, *Imshaugia aleurites, Hypogymnia* sp. pl., *Lecidea hypopta, Ochrolechia* sp. pl. and *Tuckermannopsis chlorophylla* were locally abundant over the north side of the tree trunks. The major species on tree bases were *Cladonia glauca, C. ramulosa, C. subulata, C. squamosa, Hypocenomyce antracophila, Micarea denigrata* and *M. prasina*. All of them were restricted to the moister habit of pine forests. However, epiphytic lichen diversity declined considerably in open *Pinus nigra* plantations covered the potentially area of *Quercus rotundifolia* forests (drier and sunny conditions) (Table 3). Calicioid taxa were absent and the most abundant species on the tree bases were *Cladonia fimbriata, Hypocenomyce scalaris, Placynthiella icmalea* and *Trapeliopsis flexuosa*, which are widespread and indifferent to specific climatic conditions.

TERRICOLOUS LICHENS - terricolous lichens grow in a wide altitudinal range, however, the greatest diversity occurs in humid conditions upper 1650 m alt. Under these extreme climatic conditions (annual temperature average to 6°C), pine black formations form low-density stands and the scrub layer are dominated by cushion chamaephytes and creeping mats. Thirty-nine lichen taxa, mostly of them with squamulose biotipe, have been found on erosion and pastured soils. *Buellia epigea, Catapyrenium daedaleum, Bilimbia lobulata, Placidium rufescens, Psora decipiens, P. globifera, Toninia sedifolia* and the vagrant *Aspicilia hispida* were common in open grassland areas. *Catapyrenium cinereum, Collema tenax, Endo-carpon pusillum, Involucropyrenium waltheri, Placidium squamulosum and Toninia opuntioides* occurs

Table 3: Epiphytic lichen diversity in *Pinus nigra* forests (lichens on bark or lignum of *P. nigra*).

Climatic conditions	Humid (P = 1100-1200 mm)				Subhumid (P = 750-900 mm)					
Localities	9	16	24	45	49	15	25	42	48	50
Forests coberture (%)	70	68	75	80	80	40	45	30	35	40
Diam. average (cm)	68	57	62	61	69	41	40	45	55	48
N° species (trunk)	36	35	37	41	39	16	25	14	20	17
N° pin lichens	7	7	7	8	10	0	0	0	1	0
N° species (tree bases)	10	11	12	14	12	3	3	2	4	3
N° *Cladonia* sp. pl.	3	4	4	5	4	1	1	0	1	1
N° species (lignum)	6	6	8	9	7	0	2	0	2	1

in the widest crevices and humid soils. *Cladonia* and *Peltigera* species were frequent on shaded forests soils or under the creeping mats. In lowland, mostly terricolous species were concentrated around the river influence and the bottom of valleys. The major species were *Catapyrenium* sp. pl., *Cladonia convoluta, C. pocillum, C. rangiformis, Collema fuscovirens, C. tenax, Leptogium lichenoides, L. schraderi, Peltigera neckeri, P. praetextata, Placidiopsis tenella* or *Solorina saccata*.

SAXICOLOUS LICHENS - vertical exposed rocks, in humid conditions, at altitudes from 1550 to 1750 m, contain the highest saxicolous lichen diversity of the study area. More specifically, 73 lichen species have been identify growing in one calcareous block of 4 m height. Some taxa with a huge altitudinal range occur on the north side of the rocky walls, sheltered of excessive sunlight. Most species develop an endolitic or crutose-epilitic thalli: *Aspicilia coronata, Caloplaca agardhiana, C. alociza, Clauzadea immersa, C. metzleri, C. monticola, Rinodina immersa, Verrucaria calciseda*. Above 1550 m alt, *Caloplaca granulosa, Farnodia jurana, Ionaspis epulotica, Lecanora crenulata, Protoblastenia inmersa, P. rupestris, Sagiolechia protuberans, Verrucaria caerulea* and *V. marmorea* were the most characteristic species in these habit. Above 1900 m altitude, *Seirophora contortuplicata* grows inside fissures of the vertical rocks, sheltering from the rain and wind. The species growing on extraplomes and exposed rocks surface developed placodioide thalli such as *Caloplaca aurantia, C. biatorina, C. saxicola, Xanthoria calcicola* and *X. elegans*.

ELEMENT ANALYSIS - a phytogeographical analyse (according to Wirth 1995) is reported. Distribution pattern of epiphytic lichens is very different to the saxicolous-terricolous taxa. In both cases, the species with wide distributional range represented the 34% of the total. Mostly of them shown certain affinity for eutrofic habit and were totally indifferent to specific climatic conditions (*Buellia, Caloplaca, Candelariella, Lecanora, Lecidella, Physcia, Rinodina* or *Xanthoria genera*).

Epiphyte: two groups of species (boreal and temperate oceanic) account for 47% of the total epiphytic flora. Most species of the boreal element grow on bark of *Pinus nigra* in humid conditions. The high percentage may be due to the mountainous relief, abundant rainfall and the large area of land covered of coniferous forests (specially *Pinus nigra*). Most species with temperate-oceanic distributional range contain cyanobacteria fotobiont. They grow in dense forests stands (*Quercus faginea* and *Q. rotundifolia*) located in deep valleys and steep ravines where moisture remains for a long time. The species restricted to the Mediterranean area in Europe (Med and Submed) represented the 8% of the total. In the studied mountains, they were found on bark of *Pinus halepensis, Olea europea, Quercus coccifera* and *Q. rotundifolia.* These forests stands are located in lowlands (500-700 m alt.) with drie to subhumid range ombroclime.

Saxicolous-terricolous: the temperate species are 38% (74% of the total element is composed of saxicolous species). They called “mieur”, with optimal distribution in central and western Europe. The species extend in the supra- and oromediterranen belt. This high percentage could be associated to the geographic situation of the Baetic mountains, far from the coast line. Only three species (*Catapyrenium cinererum, C. daedaleum* and *Involucropyrenium waltheri*) with an artic-alpine distributional

rank and growing on exposed soils upper 1740 m altitude were found. The mediterranean element (13%) mainly appears in the mesomediterranean belt.

Acknowledgments

We express our thanks to Dr I.Martínez (Spain), A.R.Burgaz (Spain), B.J.Coppins (British Isles), J.Etayo (Spain), M.Giralt (Spain), P.M.Jørgensen (Norway), L.Tibell (Sweden), F.J.Sarrión (Spain), Ch.Printzen (Norway) and D.Puntillo (Italy) for identifications/verifications of critical species. We also thanks to Dr Brezo Martínez and the anonymous referees for their valuable comments.

References

ARAGÓN, G. & M.A.G. OTÁLORA (2004): Ecological and chorological novelties of the genus Leptogium in the Iberian Peninsula. - Nova Hedwigia **78** (3-4): 353-366.

ARAGÓN, G. & V. J. RICO (1997): Los macrolíquenes del macizo del Calar del Mundo (Albacete) y de la Sierra de Segura (Jaén, España). - Lazaroa **18**: 45-93.

ARAGÓN, G. & F.J. SARRIÓN (2003): Epiphytic Verrucariaceae (Lichens) in Mediterranean Spain. - Nova Hedwigia **77** (1-2): 169-187.

ARAGÓN, G., M.A.G. OTÁLORA & I. MARTÍNEZ (2005): New data of the genus Leptogium (Ach.) Gray in the Iberian Peninsula. - Nova Hedwigia **80** (1-2): 199-226.

ARAGÓN, G., F.J. SARRIÓN & I. MARTÍNEZ (2004): Epiphytic lichens on *Juniperus oxycedrus* L. in the Iberian Peninsula. - Nova Hedwigia **78** (1-2): 45-56.

DEGELIUS, G. (1954): The lichen genus Collema in Europe. Morphology, taxonomy, ecology. - Symb. Bot. Upsal. **13**: 499 pp.

HAFELLNER, J. & R. TÜRK (2001): Die lichenisierten Pilze Österreichs - eine Checkliste der bisher nachgewiesenen Arten mit Verbreitungsangaben. - Stafia **76**: 3-167.

KIRK, P.M., P.F. CANNON, J.C. DAVID & J.A. STALPERS (2001): Ainsworth & Bisby's Dictionary of the Fungi. 9th Edn. Wallingford: CAB International.

MARTÍNEZ, I. (1999) Taxonomía del género *Peltigera* Willd. (Ascomycetes liquenizados) en la Península Ibérica y estudio de sus hongos liquenícolas. - Ruizia **15**: 1-200.

MARTÍNEZ, I. & G. ARAGÓN (2004): The *Lecanora varia* group in Spain: Species with Amphitecial Cortex. - The Bryologist **107** (2): 222-230.

MORENO, P.P & J.M. EGEA (1991): Biología y taxonomía de la familia Lichinaceae, con especial referencia a las especies del SE español y norte de África. Resumen Tesis Universidad de Murcia, Secret. Publicac. 87 pp. Murcia

MORENO, P.P., J.M. EGEA & P. TORRENTE (1987): Flora liquénica epifítica del Campamento del río Madera (Sierra de Segura). - Actas VI. Simposio Nac. Bot. Criptog.: 419-429.

RIVAS-MARTÍNEZ, S. (1993): Bases para una nueva clasificación bioclimática de la tierra. - Folia Bot. Matritensis **10**: 1-23.

ROSELLÓ, R.E. & O. SÁNCHEZ (1991): Los pinares españoles de Pinus nigra Arn.: síntesis ecológica. - Monografías INIA **81**: 1-110.

SARRIÓN, F.J., G. ARAGÓN & A.R. BURGAZ (1999): Studies on mazaediate lichens and calicioid fungi of the Iberian Peninsula. - Mycotaxon **71**: 169-198.

SARRIÓN, F.J., G. ARAGÓN, J. HAFELLNER, V.J. RICO & A.R. BURGAZ (1999): Two new species of *Mycobilimbia* from Spain. - Lichenologist **35** (1): 1-10.

VALLE, F., F. GÓMEZ-MERCADO, J.F. MOTA & C. DÍAZ DE LA GUARDIA (1989): Parque Natural de Cazorla, Segura y Las Villas. Guía botánico-ecológica. Ed. Rueda. Alcorcón (Madrid). 354 pp.

WHITE, F.J. & P.W. JAMES (1985): A new guide to microchemical techniques for the identification of lichen substances. - Brit. Lich. Soc. Bull. **57** (Suppl.): 1-41.

WIRTH, V. (1995): Flechtenflora, 2. Ulmer, Stuttgart. 661 pp.

Received 21 November 2004, accepted in revised form 4 May 2005.