JSE Journal of Systematics and Evolution

doi: 10.1111/jse.12503

Research Article

Substrate switches, phenotypic innovations and allopatric speciation formed taxonomic diversity within the lichen genus *Blastenia*

Jan Vondrák[1,2]*, Ivan Frolov[2,3], Jiří Košnar[2], Ulf Arup[4], Tereza Veselská[5], Gökhan Halıcı[6], Jiří Malíček[1], and Ulrik Søchting[7]

[1]Institute of Botany of the Czech Academy of Sciences, Průhonice CZ-252 43, Czech Republic
[2]Department of Botany, Faculty of Science, University of South Bohemia, České Budějovice CZ-370 05, Czech Republic
[3]Russian Academy of Sciences, Ural Branch: Institute Botanic Garden, Vosmogo Marta 202a st., Yekaterinburg 620144, Russia
[4]Botanical Museum, Lund University, Lund SE-221 00, Sweden
[5]Institute of Microbiology, Academy of Sciences of the Czech Republic, Praha 4-Krč CZ-142 20, Czech Republic
[6]Gökhan Halıcı, Department of Biology, Faculty of Science, Erciyes University, Kayseri 38039, Turkey
[7]Department of Biology, Section for Ecology and Evolution, University of Copenhagen, Copenhagen DK-2100, Denmark
*Author for correspondence. E-mail: j.vondrak@seznam.cz; Tel.: 420776280011.
Received 9 January 2019; Accepted 11 April 2019; Article first published online 29 April 2019

Abstract *Blastenia* is a widely distributed lichen genus in Teloschistaceae. We reconstructed its phylogeny in order to test species delimitation and to find evolutionary drivers forming recent *Blastenia* diversity. The origin of *Blastenia* is dated to the early Tertiary period, but later diversification events are distinctly younger. We recognized 24 species (plus 2 subspecies) within 6 infrageneric groups. Each species strongly prefers a single type of substrate (17 species occur on organic substrates, 7 on siliceous rock), and most infrageneric groups also show a clear substrate preference. All infrageneric groups tend to have the Mediterranean and Macaronesian distribution, but some epiphytic species have much larger geographic ranges and some evolved after a long-distance dispersal outside the region. Chlorinated and nonchlorinated anthraquinone chemosyndromes co-occur in apothecia of most species, but the chemotype has been secondarily reduced in some lineages. One infrageneric group has a marked reduction in apothecial size, associated with a substrate shift to twigs. Only seven species have vegetative diaspores; they also produce apothecia but have smaller ascospores. Genome sizes (22–35 Mb in *Blastenia*) are significantly higher in epilithic species. Within-species genetic variation is low in widely distributed species but high in some epilithic species with small geographical ranges. New taxa are: *B. afroalpina*, *B. anatolica*, *B. caucasica*, *B. gennargentuae*, *B. herbidella* subsp. *acidophila*, *B. lauri*, *B. monticola*, *B. palmae*, *B. psychrophila*, *B. purpurea*, *B. relicta*, *B. remota*, *B. xerothermica*, and *B. xerothermica* subsp. *macaronesica*. New combinations are: *B. festivella* and *B. subathallina*; both names and *B. catalinae* are lectotypified.

Key words: anthraquinones, genome size, long-distance dispersal, Mediterranean–Macaronesian diversity hot-spot, Teloschistaceae, vegetative diaspores.

1 Introduction

The genus *Blastenia* (Ascomycota, Lecanoromycetidae, Teloschistaceae) was introduced by Massalongo (1852a, 1852b) for a group of crustose species with "blasteniospores" and with a reddish tinge to the apothecial disc. Massalongo's term blasteniospore refers to what we now call polarilocular ascospores. He coined the term, with more learning than judgment, from the Greek noun βλαστός, "a shoot of a plant"; presumably, he regarded the two locules as sprouting from the center of the ascospore. Massalongo included seven species. Later authors were less restrained and over 360 names have been published within *Blastenia*, many of them for taxa not closely related to Massalongo's concept of the genus and some for taxa that do not even belong in Teloschistaceae.

Massalongo did not designate a type for *Blastenia*, but Clements & Shear (1931) designated *B. ferruginea* as a type. In the decades following 1931, most authors treated that species within *Caloplaca*, as *C. ferruginea*, and consequently *Blastenia* fell into disuse, being regarded as a synonym of *Caloplaca*. Arup et al. (2013) resurrected the name *Blastenia* and gave the genus a more precise circumscription, mainly on the basis of three-loci phylogeny. In their sense, it is a genus close to *Gyalolechia* in the subfamily Caloplacoideae, with nine species. Taxonomic literature dealing with *Blastenia* in its recent sense is sparse; the main sources are Magnusson (1944a, 1944b); Wetmore (1996, 2004); Arup et al. (2007); Søchting et al. (2008); Arup & Åkelius (2009); Kondratyuk et al. (2009a); and Vondrák et al. (2013b).

While studying Turkish Teloschistaceae, it became clear that numerous species belonging to *Blastenia* were undescribed and

© 2019 Institute of Botany, Chinese Academy of Sciences

this led us to make a taxonomic study of the genus using DNA sequence data and including putative members of the genus from other parts of the world. Our original intention was merely to prepare a clear taxonomic summary of the genus, but while doing that, we were led to consider the question of what has driven diversification in this genus, and we discuss that topic here too.

Using three DNA loci, we first set the following three goals.

1. Determine species richness and describe the diversity within the genus.
2. Reconstruct the evolutionary history and development of (i) geographical ranges; (ii) ecology; and (iii) selected morphological traits.
3. Determine the genome size (GS) of all species.

We then formulated the following seven hypotheses:

1. Ecology: Each species of *Blastenia* is restricted to either organic or inorganic substrates.
2. Geography: Evolution of *Blastenia* has occurred mostly in the Mediterranean basin and Macaronesia.
3. Within-species genetic variation: The greatest within-species genetic variation occurs in epilithic species with Mediterranean-Macaronesian distribution.
4. Secondary metabolites: The ancestral chemotype was complex, and reductions have led to the several chemotypes observed today.
5. Morphology: In those species that have shifted to twigs: (i) apothecial size has reduced, and (ii) it has done so because of the substrate shift.
6. Morphology: Vegetative diaspores are a derived character in *Blastenia* and are linked to the reduction of the ascospore size.
7. Genome size: Genome sizes are higher in epilithic species.

We present evidence in support of each of these hypotheses.

2 Material and Methods

2.1 Sampling

We searched for *Blastenia* in numerous regions in all continents and surveyed more than a thousand specimens from the western Palearctic, mainly Mediterranean regions and Macaronesia. There are few specimens from the eastern Palearctic and other continents. (As discussed below, we consider that this difference reflects the true distribution of the genus and that the lesser amount of research in those other regions is not materially biasing our study.) Specimens were mainly collected by the authors and are deposited in PRA (Vondrák), LD (Arup), ERC (Halıcı), C (Søchting), and in Frolov's and Malíček's personal herbaria. A significant number of specimens were collected by Evgeny Davydov (ALTB), Josef Hafellner (GZU), Zdeněk Palice (PRA), Irina Urbanavichene (PRA), and Gennadii Urbanavichus (PRA). Other collectors are acknowledged below. Although we studied more than one thousand specimens, DNA sequence data were only generated for 350 specimens (Table S1).

2.2 Molecular protocols

DNA was extracted with a cetyltrimethylammonium bromide (CTAB)-based protocol (Aras & Cansaran, 2006). Three DNA loci were amplified: beta-tubulin nuclear gene, large subunite mitochondrial ribosomal gene (mtLSU in further text), and internal transcribed spacer (ITS) region of nuclear ribosomal DNA (ITS in further text). Polymerase chain reactions were performed in a reaction mixture containing 2.5 mmol/L $MgCl_2$, 0.2 mmol/L of each dNTP, 0.3 μmol/L of each primer, 0.5 U Taq polymerase (Top-Bio, Praha, Czech Republic) in the manufacturer's reaction buffer, and sterile water to make up a final volume of 10 μL. The primers and the cycling conditions are summarized in Table 1. Successful amplifications were sent for Sanger sequencing (GATC Biotech, Konstanz, Germany). The amplification primers were used as the sequencing primers.

2.3 Alignments, phylogenetic analyses, and genotype variability assessment

Sequences were edited in BioEdit 7.2.5 (Hall, 1999) and aligned by MAFFT version 7 (Katoh & Standley, 2013; available online at http://mafft.cbrc.jp/alignment/server/) with the L-INS-i method (Katoh et al., 2005). Gaps were coded as binary data in SeqState by simple coding (Simmons & Ochoterena, 2000). For the concatenated dataset analysis, we used specimens with sequence data from at least two of the three loci (172 specimens). Single-gene analyses included 336 sequences of ITS, 145 sequences of beta-tubulin, and 131 sequences of mtLSU. Further information on alignments is in Table 2. Alignments are available at TreeBASE (http://purl.org/phylo/treebase/phylows/study/TB2:S21434).

Table 1 Details to sequenced loci

Locus	Reference	Primers	PCR settings
ITS	Gardes & Bruns (1993)	ITS1F (forward): CTTGGTCATTTAGAGGAAGTAA; ITS4 (reverse): TCCTCCGCTTATTGATATGC	94 °C - 3 min; 7×: 94 °C - 30 s, 62 °C - 30 s (temperature was decreased by 1 °C in each subsequent cycle), 72 °C - 60 s; 38×: 94 °C - 30 s, 56 °C - 30 s, 72 °C - 60 s; 72 °C - 10 min
Beta-tubulin	Designed for this study	TubCf1 (forward): ATATGTTCCCCGTGCTGT; TubCr1 (reverse): ATCATGTTCTTTGGGTCGAA	94 °C - 10 min; 40×: 94 °C - 30 s, 53 °C - 30 s, 72 °C - 60 s; 72 °C - 10 min
mtLSU	Designed for this study	mLSU Cf (forward): GGGGGTCGTGAAGATTCTAT; mLSU Cr (reverse): CCAGAACACTTATCACTTTTACACA	94 °C - 10 min; 40×: 94 °C - 30 s, 56 °C - 30 s, 72 °C - 60 s; 72 °C - 10 min

Phylogenetic reconstructions were carried out using maximum likelihood and Bayesian inference. Models of nucleotide substitutions (Table 2) were selected using the Akaike information criterion implemented in jModelTest v.0.1.1 (Posada, 2008). Bayesian analysis was performed using MrBayes 3.1.2 (Huelsenbeck & Ronquist, 2001; Ronquist & Huelsenbeck, 2003). It was employed for the single-gene alignments and concatenated alignment (Figs. 1 and 2). Analyses were performed using two independent runs with four Markov chain Monte Carlo (MCMC) chains. Trees were sampled after every 500th generation. The analyses were stopped when the average standard deviation (SD) of the split frequencies between the simultaneous runs dropped below 0.01. The first 25% of trees were discarded as the burn-in phase, and the remaining trees were used for the construction of a 50% majority consensus tree.

We expressed the within-species genotype variability by counting polymorphic sites in single-loci alignments (Table 3). Each indel position was considered one character. We also divided the number of polymorphic sites in all loci by the number of all generated sequences to make the data more objective.

2.4 *BEAST: Species tree with dated nodes and with ancestral state mapping

*BEAST as implemented in BEAST v.2.4.5 (Drummond & Rambaut, 2007) was run on the same sequence dataset as employed for Bayesian inference. We used the Site model GTR+G4, Strict Clock model, the Yule model, constant population function and default values for the remaining priors. Two independent MCMC analyses were performed for a total of 100 million generations, sampling every 5000 steps. The convergence of the two runs and the adequacy of sampling were assessed with Tracer v.1.6 (Rambaut et al., 2014). After removing the first 20% of the samples as burn-in, the runs were combined to generate posterior probabilities of nodes from the sampled trees using TreeAnnotator v.2.4.5 (Rambaut & Drummond, 2009).

Dating of nodes was calibrated by two events adopted from Gaya et al. (2015): the divergence time of *B. catalinae* from *B. crenularia* (10.5 ± 4.5 million year ago (Mya)) and the divergence time of *B. ammiospila* from those two species (22.5 ± 7.5 Mya). We are aware of the approximate character of priors and we used the dated tree mostly for relative estimation of taxa ages.

Ancestral state reconstruction was performed for three phenotype characters: types of secondary chemistry, presence/absence of vegetative diaspores, and substrate ecology. We mapped the characters as binary data to species tree terminals and ran the *BEAST (in the version 2.3.2 enabling this analysis) with the same settings as described above. The input data and results of the analysis are depicted in Fig. 3.

2.5 BP&P: Species delimitation

Bayesian phylogeny based on the concatenated data-set of ITS, beta-tubulin, and mtLSU sequences served as a phylogenetic hypothesis for testing species delimitations. Twenty-six groups resolved in the concatenated tree or in some single-locus trees were tested for species delimitation (see below).

The putative taxa were evaluated using Bayesian MCMC analysis for multi-loci data under the multispecies coalescent model (Rannala & Yang, 2003; Yang & Rannala, 2010). The joint analysis of species delimitation and species-tree estimation (Yang & Rannala, 2014) was conducted using the program BP&P v.3.1 (Yang, 2015). This method accommodates uncertainty in the species phylogeny as well as lineage sorting due to ancestral polymorphism. The species tree inferred by *BEAST was used as a starting tree. The rjMCMC algorithm 1 ($\alpha = 2$, $m = 1$) was used to change the species delimitation model and the NNI/SPR move was used to change the species tree topology. Species model prior was set to equal probabilities for rooted trees. A gamma prior G (1, 15), with mean 1/20 = 0.05 (one difference per 15 bp), was used on the population size parameters. The age of the root in the species tree was assigned the gamma prior G(2, 2000), which means 0.1% of sequence divergence, while the other divergence time parameters were assigned the Dirichlet prior (Yang & Rannala, 2010: equation 2). The mutation rate among loci was specified using a random-rates model ($\alpha = 20$). The first 8000 MCMC iterations were set as burn-in. A total of 200 000 post-burn-in iterations were carried out, and MCMC samples were taken in each iteration. The analysis was run three times to confirm consistency between runs. The species or subspecies with posterior probability consistently exceeding a threshold of 0.95 were accepted as distinct taxa.

2.6 Morphological descriptions

All detailed studies on morphology were carried out after analyzing DNA sequence data when the species boundaries had been settled. First, we conducted a pilot study where we studied a couple of specimens from hardly distinguishable species: (Group 1) epilithic species without vegetative

Table 2 Basic information on alignments

Alignment	Number of sequences	Lenght of alignment/Number of indel codes	Variable characters (all/ ingroup only)	Parsimony informative characters (all/ ingroup only)	Nucleotide substitution model
ITS	336	577/122	433/396	317/295	GTR+G
beta-tubuline	145	677/8	290/267	235/230	HKY+I+G
mtLSU	131	764/39	292/228	218/146	HKY+G
Concatenated (ITS/ beta-tubuline/mtLSU)	172	2005/134	928/827	717/611	GTR+G/HKY+I+G/ HKY+G

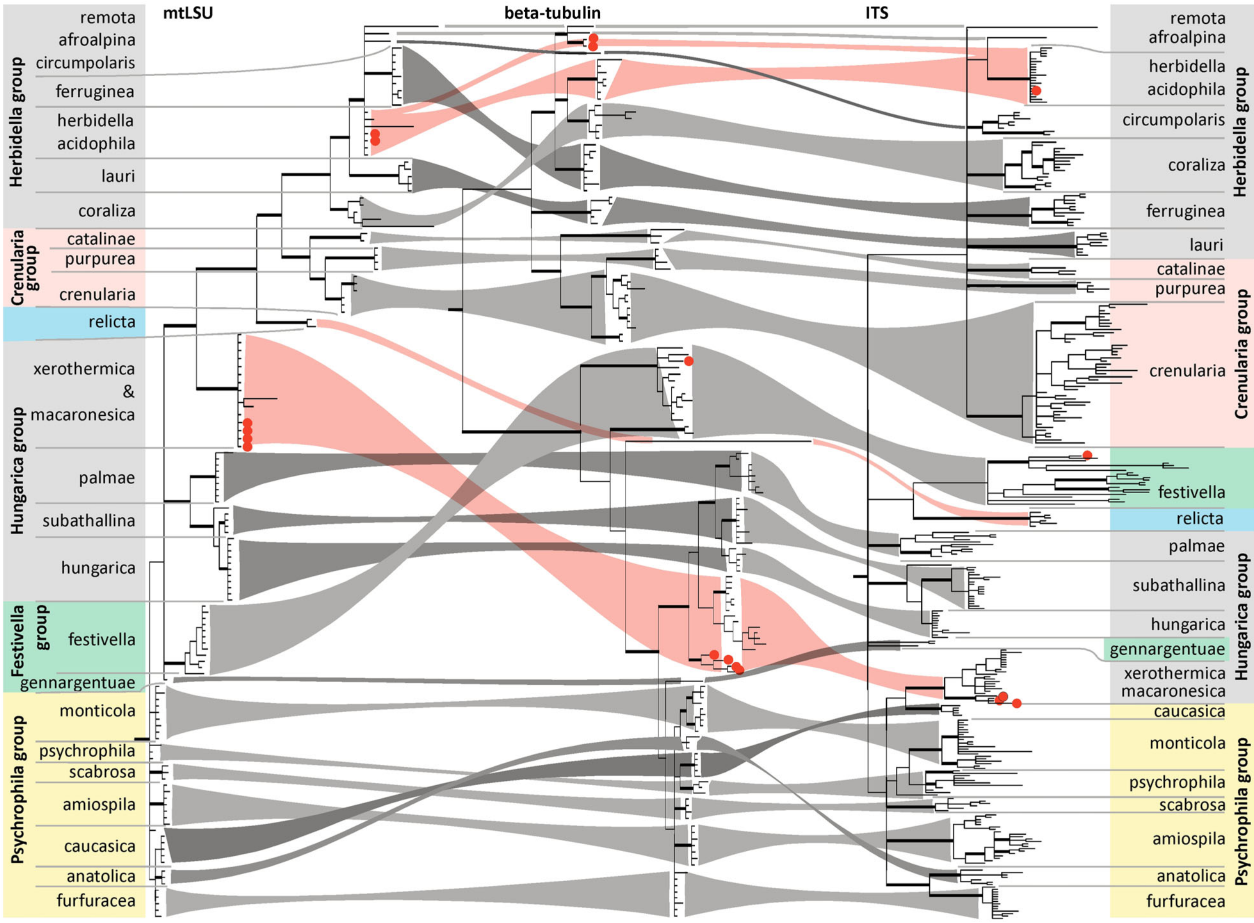


Fig. 1. Bayesian single gene phylogeny reconstructions. Supported clades (pp > 0.95) indicated by thick branches. Clades representing species are connected by grey or red links. Red links indicate taxa with incongruent topologies between single gene phylogenies. Six infrageneric groups are indicated at the right and left margins. The red dots indicate positions of *Blastenia herbidella* subsp. *acidophila*, *B. xerothermica* subsp. *macaronesica* and the epiphytic population of *B. festivella*.

diaspores and (Group 2) epiphytic species without vegetative diaspores. We realized that variability in numerous morphological and anatomical characters is substantial, but most characters are strongly variable within species and do not show differences between species (see the genus description in the taxonomic part). For that reason, we have reduced the morphological descriptions of species in this paper so that they include only diagnostic characters, mainly morphology of vegetative diaspores (if present), thallus thickness, apothecial size, ascospore length and the color of thallus, apothecia, and pycnidia.

The methods for morphological evaluation follow Vondrák et al. (2013a). All observations were done on hand-cut sections in water, without any chemical treatments. Measurements are accurate to 0.5 μm for ascospore size, the width of ascospore septa and width of paraphyses, 1 μm for sizes of vegetative cells and width of asci or 10 μm for larger scales. All measurements of cells include their walls, except for tissues with glutinized cell walls. Following Ekman (1996), the results of ascospore length measurements are given as (min.–) X1–X2–X3 (–max.), where X1 is the lowest specimen arithmetic mean observed, X2 is the arithmetic mean of all observations, and X3 is the highest specimen arithmetic mean observed. SD, the total number of measurements (*N*), and number of investigated samples (*n*) measured in each species are given in square parenthesis [*SD*; *N*; *n*]. Morphological terminology follows Smith et al. (2009) and Vondrák et al. (2013a).

2.7 Identification of secondary metabolites

Most lichen substances present in *Blastenia* are anthraquinones (yellow to red pigments) and are known from previous studies (e.g., Søchting, 1997, 2001). Their characteristics are available in Elix (2014), including their thin layer chromatography (TLC) response factor (RF) values. With the help of these published data, we were able to identify the dominant substances of all *Blastenia* species by TLC (solvents B', C). We used the purple spot reaction with hypochlorite ion ("C" reagent) for detection of chlorinated anthraquinones and also for their spatial distribution within apothecia (see Vondrák & Wirth, 2013; Vondrák et al., 2013a for details). We specifically noted the presence/absence of chlorinated anthraquinones in epihymenium (apothecial disc) and exciple.

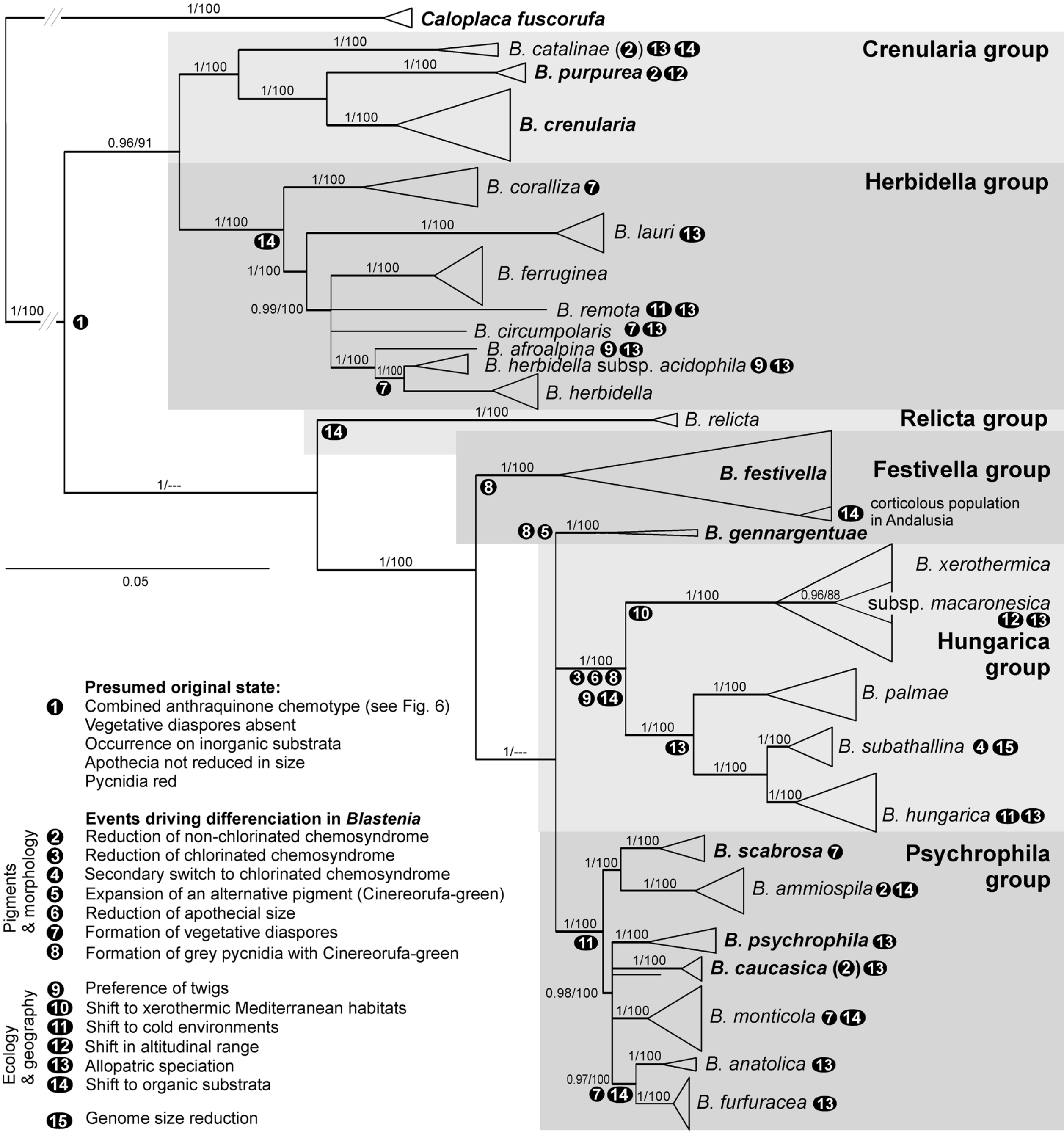


Fig. 2. Bayesian phylogeny of the concatenated dataset of beta-tubulin, ITS and mtLSU loci. Bayesian posterior probabilities and bootstrap supports from the maximum likelihood analysis (after slashes) are shown above branches. Branches with posterior probability >0.95 are thick. Six infrageneric groups are indicated by shading. Names in bold indicate epilithic taxa. Clades recognized at species level are displayed as triangles. Length of triangle (horizontal dimension) reflects genotype diversity within clades. Height of triangle reflects sampling size. Character states are listed in the bottom left corner and mapped onto the tree.

For authentication of TLC identifications, eight samples were subsequently analyzed by LC-MS (ultra performance liquid chromatography and mass spectrometry): 3x *Blastenia ammiospila*, *B. ferruginea*, *B. monticola*, *B. palmae*, *B. purpurea* and *B. subathallina*. Apothecia together with adjacent thallus were extracted in methanol using an ultrasonic device. The LC-MS methods followed Valný et al. (2016) with a few modifications: the analyses were performed under a linear gradient program (min/%B) 0/5, 1.5/5, 12.5/58 followed by a 1.5-minute column clean-up (100% B) and 1.5-minute equilibration (5% B); the total analysis time was 20 minutes. The mass spectrometer was operated in the W mode. Individual

Table 3 Within species variability in the three loci expressed by number of variable nucleotide positions. Species of *Blastenia* ordered according to the ratio in the last column. Numbers of available sequences are given in brackets at each species in order: ITS, mtLSU and beta-tubulin. Saxicolous species in bold; species with vegetative diaspores underlined; questionmarks indicate unknown variability in nucleotide positions

	Variable nucleotide positions				
Species	ITS	mtLSU	Beta-tubulin	All loci	Variable positions in all loci/number of all sequences
B. gennargentuae **(3,1,1)**	12	?	?	12	4.00
B. festivella **(21,12,7)**	85	11	63	159	3.98
B. catalinae (5,2,3)	16	?	11	27	3.38
B. psychrophila **(10,4,3)**	23	7	3	33	1.94
B. circumpolaris (8,1,1)	15	?	?	15	1.50
B. crenularia **(43,6,11)**	56	5	25	86	1.43
B. palmae (15,9,8)	34	1	9	44	1.38
B. caucasica **(7,5,6)**	16	0	7	23	1.28
B. coralliza (17,5,6)	20	6	7	33	1.18
B. lauri (9,5,5)	10	4	7	21	1.11
B. ferruginea (11,9,8)	17	2	9	28	1.00
B. relicta (5,2,1)	5	?	?	5	1.00
B. anatolica (7,3,3)	8	0	3	11	0.85
B. xerothermica (29,15,18)	21	0	28	49	0.79
subsp. *xerothermica* (25,11,13)	16	0	19	35	0.71
subsp. *macaronesica* (4,4,5)	7	0	8	15	1.15
B. scabrosa **(6,3,5)**	4	2	5	11	0.79
B. monticola (20,9,8)	20	2	6	28	0.76
B. purpurea **(4,4,4)**	5	0	4	9	0.75
B. herbidella (24,7,9)	4	2	23	29	0.73
subsp. *herbidella* (22,5,7)	4	2	3	9	0.26
subsp. *acidophila* (2,2,2)	?	?	?	?	?
B. subathallina (19,5,5)	12	6	1	19	0.65
B. ammiospila (21,7,7)	18	2	1	21	0.60
B. furfuracea (14,5,7)	6	1	0	7	0.27
B. hungarica (12,11,9)	5	1	1	7	0.22

metabolites were identified in UV (DAD detector) and in the negative mode of electrospray ionization, which worked with higher efficiency compared to the positive mode.

Cinereorufa-green (an accessory green-black pigment) is not extractable by acetone and not detectable by TLC, but it was detected in sections of tissue by the negative reaction with KOH and the violet reaction with nitric acid.

2.8 Flow cytometry: Genome size assessment

Flow cytometry was carried out on isolated nuclei by the method described in Veselská et al. (2014) with a few modifications, using *Aspergillus fumigatus* CEA10 with a GS of 29.2 Mb (Fedorova et al., 2008) as an external standard for GS calculations. Lichen apothecia or sterile mycelium of *A. fumigatus* were fixed in methanol: acetic acid (3: 1 v/v), 10% DMSO, 0.1% Triton X-100 for one hour at 4 °C and then washed with 0.1% Triton X-100. The samples were then chopped using a razor blade in Tris-$MgCl_2$ buffer supplemented with RNAse A (0.1 mg/mL). The suspension containing released nuclei was filtered through a 20 μm nylon filter to remove large debris and incubated at 37 °C for 15 min. Samples were measured immediately after Propidium iodide (Fluka, Glossop, England)—final concentration of 50 μg/mL—was added on the LSRII machine (Becton Dickinson, NJ, USA) with FACSDiva 6 Software (Becton Dickinson) at the Service Centre for Cytometry and Microscopy of the Institute of Microbiology, ASCR, Czech Republic. All fluorescent events were recorded. The measurement was stopped when 10 000 events were captured within the area responding to the signals of labeled nuclei. The output was processed in FlowJo 7.6.1 (Tree Star, Ashland, TN, USA). The relationships between lichens GS and their ascospore length, apothecia size, substrate preference, and abiotic conditions were tested with the program PAST using a linear RMA model or Mann–Whitney test.

The GS was assessed for herbarium specimens with a broad range of age (1990–2015), but 25 of 35 measured specimens were collected after 2009. Old specimens had apparently lower GS and higher coefficient of variation (CV value) than younger ones. Therefore, we decided to test the effect of specimen age on estimated GS. We chose *B. herbidella* (epiphytic) and *B. crenularia* (epilithic) as model species. In *B. herbidella*, we found stable GS, about 30.9 Mb, in specimens collected between 2013 and 2016, but specimens from 2004–2009 had smaller GS, between 23.4 Mb and 26.1 Mb. Ten specimens collected in 1951–1997 produced no histograms. The data obtained from *B. crenularia* revealed less age-induced genomic change. Genome sizes for this species remain stable over the period 2007–2016. Only a single specimen from 1990 had markedly lower GS,

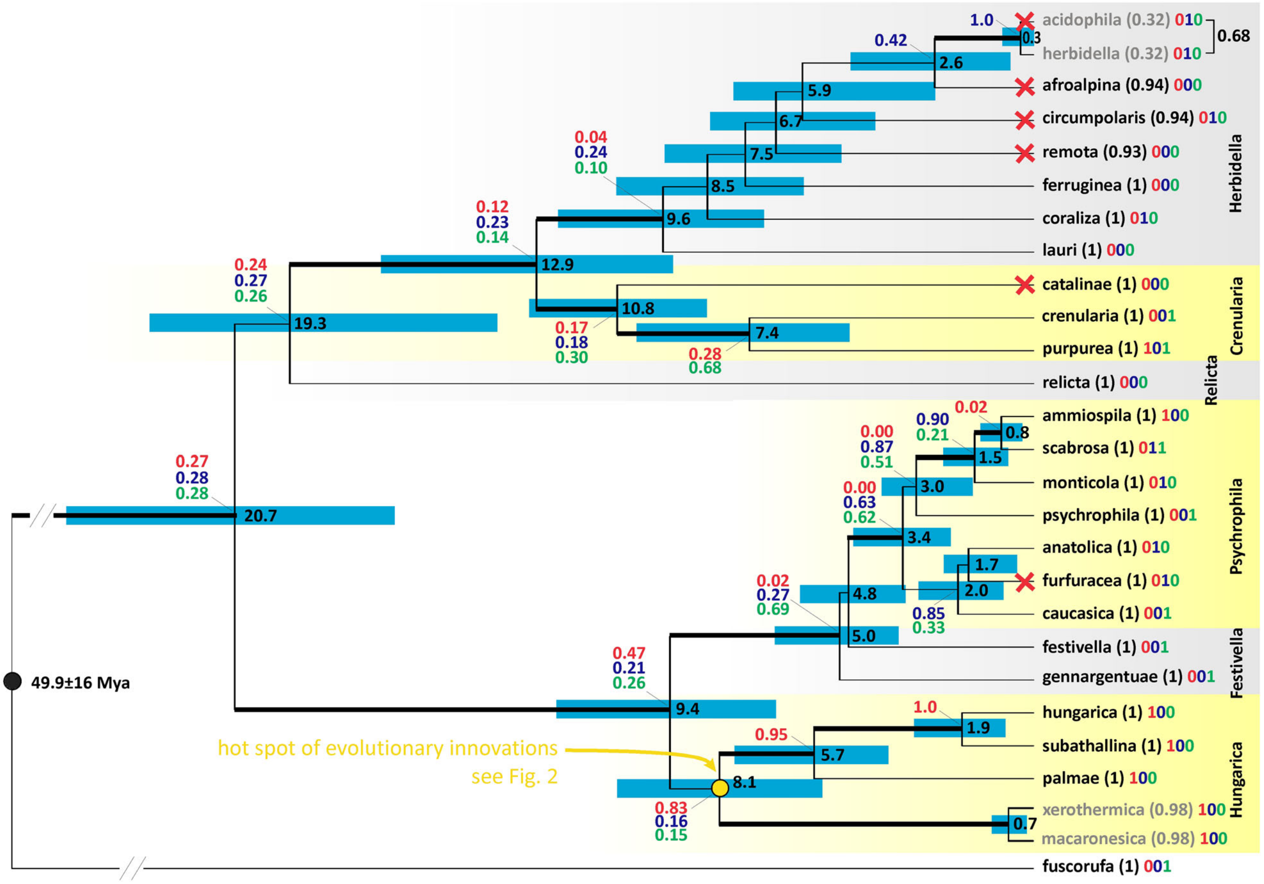


Fig. 3. Species tree reconstructed by *BEAST with estimated divergence time for the nodes. Terminal names in black are recognized as species; grey names are considered subspecies. Infrageneric groups are indicated on the right. Branches supported by posterior probabilities (PP ≥ 0.95) are thick. Nodes are dated in millions of years, with the 95% credibility intervals (blue boxes). Average posterior probabilities from three BP&P runs are indicated for each taxon and some groupings (numbers in brackets after names of taxa). Red numbers are probabilities of the reduced anthraquinone chemotypes (see Fig. 6). Blue numbers are probabilities of vegetative diaspore presence. Green numbers are probabilities of occurrence on inorganic subsrata. Taxa distributed only outside the Mediterranean-Macaronesian diversity hotspot are indicated by red crosses.

22.6 Mb (compared to 29–35 Mb in other samples). Based on these tests, we only included data from specimens more recent than 2009 (Table S2) in tracing characteristics linked with the GS.

3 Results

3.1 *Blastenia* includes 6 infrageneric groups, 24 species, and 2 subspecies

A single-locus ITS analysis of Caloplacoideae revealed a group of taxa around *Caloplaca fuscorufa* that is close to *Blastenia*. In all our unrooted trees (single-loci and concatenation), the *C. fuscorufa* clade has a distinctly longer branch than any *Blastenia* clade. We regard it as being outside *Blastenia* and we employ it as an outgroup for rooting our analyses (Figs. 1 and 2). The coalescent-based species tree (Fig. 3) also implied that *C. fuscorufa* is outside *Blastenia*.

Single-gene topologies are generally congruent, with only a few exceptions indicated by red links in Fig. 1. Although the backbones of single-locus trees are unresolved or only poorly resolved, the concatenated tree (Fig. 2) and the *BEAST species tree (Fig. 3) have a well-resolved backbone structure and allow division of *Blastenia* into several infrageneric groups. As few as four or as many as seven such groups could reasonably be recognized, but we recognize six (Fig. 2), as this seems most consistent with the data on geographical ranges (Fig. 4), ecological preferences (Table 4), and morphology (see the Taxonomy part). For the convenience of discussion, we merged *B. festivella* and *B. gennargentuae* into a single group even though they do not form a monophyletic group in any analysis. The two species are close, and both have a sister relationship to the Psychrophila group (Fig. 3). They also share most phenotypic characters but are restricted in their altitudinal range.

The groups were further divided into 26 taxa that we tested for species delimitation by BP&P (Fig. 3). The delimitation of 19 taxa was clearly supported (PP = 1.00). Support for *B. afroalpina*, *B. circumpolaris*, and *B. remota* was slightly lower (PP = 0.90–0.99), probably because

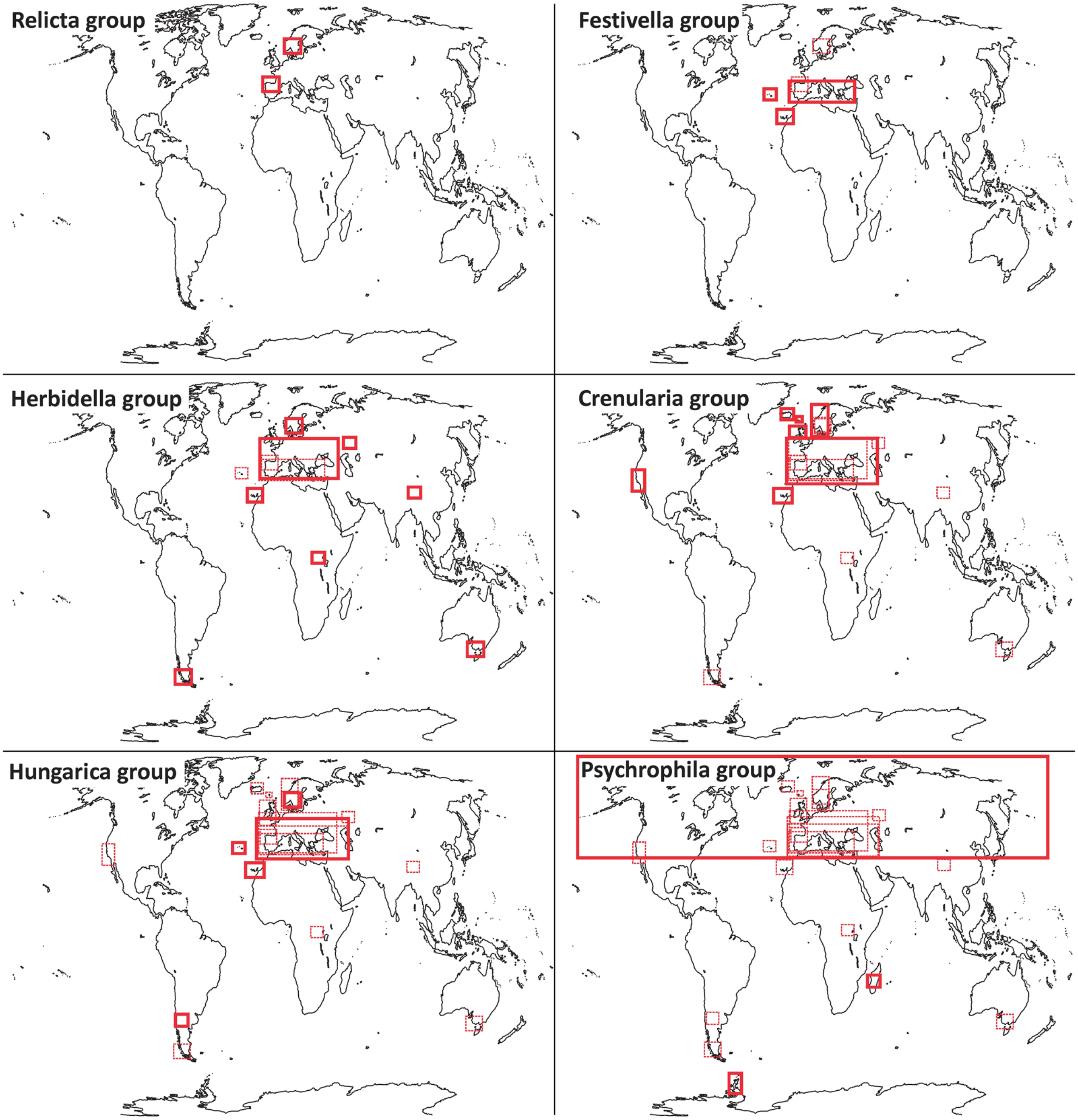


Fig. 4. World distribution of the six infrageneric *Blastenia* groups. Distribution maps are ordered according to increasing size of geographical ranges. Thick lines delimit approximate ranges of the groups; thin dotted lines indicate nestedness of all groups in the Mediterranean and adjacent regions.

phylogenetic information is scarce, as only one specimen with a full three-locus dataset is involved for each taxon here. The putative taxa "*xerothermica*" and "*macaronesica*" received PP = 0.98 (Fig. 3), but their grouping, when both taxa were merged, received PP = 1; we regard them as subspecies within *B. xerothermica*, because they are sufficiently resolved only in the beta-tubulin single-gene phylogeny (more details in the taxonomic section). The putative taxa "*herbidella*" and "*acidophila*" were poorly supported (PP = 0.32 for both), but their grouping received higher support (PP = 0.68) and received PP = 1 when the two taxa were merged into a single putative species (data not shown). We regard them as subspecies within *B. herbidella*, as they are geographically and ecologically distinct, but are not resolved in ITS and mtLSU phylogenies (they are polyphyletic in beta-tubulin; see red dots in Fig. 1). Altogether, we recognized 24 taxa at the rank of species and 2 at the rank of subspecies.

Table 4 Substrate preferences of species and infrageneric groups within *Blastenia*. Predominant substrates are in bold

Infrageneric groups	species (No. of specimens)	Organic substrates: plant debris, mosses	alpine shrubs	wood	coniferous trees (not twigs)	deciduous trees (not twigs)	coniferous trees (twigs)	deciduous trees (twigs)	Mediterranean & coastal shrubs	Inorganic substrates: siliceous rocks in arctic / (sub) alpine zone	siliceous inland non-alpine rock	siliceous coastal rock
Crenularia group	*B. catalinae* (3)							2	1			
	B. crenularia (118)			3							**71**	**44**
	B. purpurea (5)										**5**	
	total per group (126)			3				2	1		**76**	**44**
Herbidella group	*B. afroalpina* (1)								1			
	B. circumpolaris (8)				**7**						1	
	B. coralliza (72)				**27**	**38**	5		2			
	B. ferruginea (52)				4	**44**		2	2			
	B. herbidella (140)			1	**28**	**106**	5					
	B. herbidella subsp. *acidophila* (4)					1	3					
	B. lauri (25)					**14**	3	8				
	B. remota (7)							**7**				
	total per group (309)			1	**66**	**203**	16	17	5		1	
Relicta group	*B. relicta* (18)					**18**						
Festivella group	*B. festivella* (53)					1			1		**21**	**30**
	B.gennargentuae (3)									2	1	
	total per group (56)					1			1	2	**22**	**30**
Hungarica group	*B. hungarica* (88)			7	4	**24**	**18**	**35**				
	B. palmae (52)			1		**9**	**15**	2	**25**			
	B. subathallina (37)				4	6	**12**	**7**	**8**			
	B. xerothermica (90)			1	6	**12**	**14**	**17**	**41**			
	total per group (264)			9	14	**51**	**59**	**61**	**74**			
Psychrophila group	*B. ammiospila* (102)	**57**	**25**	5		5	6	5		1		
	B. anatolica (5)			3	2							

Continued

Table 4 Continued

Infrageneric groups	species (No. of specimens)	Organic substrates								Inorganic substrates		
		plant debris, mosses	alpine shrubs	wood	coniferous trees (not twigs)	deciduous trees (not twigs)	coniferous trees (twigs)	deciduous trees (twigs)	Mediterranean & coastal shrubs	siliceous rocks in arctic / (sub) alpine zone	siliceous inland non-alpine rock	siliceous coastal rock
	B. caucasica (8)									**8**		
	B. furfuracea (11)			**6**		**4**	1					
	B. monticola (52)		8	**18**	**20**	4	2					
	B. psychrophila (23)									**23**		
	B. scabrosa (12)									**12**		
	total per group (214)	**57**	**33**	**32**	22	13	9	5		**44**		

3.2 *Blastenia* history since its early tertiary origin

We dated the origin of *Blastenia* to the period 66–34 Mya, i.e., somewhere within the first half of the Tertiary period when *Blastenia* separated from the *Caloplaca fuscorufa* group (Fig. 3). All infrageneric groups are much younger; the clade including the Festivella, Hungarica and Psychrophila groups separated from the clade of the Crenularia, Relicta, and Herbidella groups within the period 26–16 Mya, i.e., late Oligocene to early Miocene. The Relicta group, which includes only a single contemporary species, is possibly the oldest extant group; it had separated by the early Miocene. Separation of the Crenularia and Herbidella groups is dated to 16–9 Mya, i.e., Miocene, separation of the Hungarica group from the Psychrophila and Festivella groups is younger, dated to 12–6 Mya. Ages of the infrageneric groups are 13–9 Mya for the Crenularia group, 12–7 Mya for the Herbidella group, 11–5 Mya for the Hungarica group, 7–3.5 Mya for the Festivella group, and 4.5–2 Mya for the Psychrophila group. The range of ages for particular species is about 10.8–0.8 Mya (Fig. 3), but that estimate could be distorted by imperfect species sampling and the absence of extinct lineages. Separations of subspecies within *B. herbidella* and *B. xerothermica* are probably more recent than 1 Mya (Fig. 3). Recent speciation is mainly in the Psychrophila group; some recognized species probably separated after 2 Mya, i.e., in the Pleistocene.

3.3 *Blastenia* species are restricted to either organic or inorganic substrates

Each species of *Blastenia* is restricted or almost restricted, to either an organic or an inorganic substrate (Table 4). Fifteen species are restricted to organic substrates, usually, bark, and two other species (*B. ammiospila* and *B. circumpolaris*) occur only rarely on inorganic substrates. We use the broad term epiphytic for these species in this paper, and do not generally distinguish between species that are epiphloedal, epixylic or occur on plant debris and bryophytes. Seven species are epilithic (reports of one of them on bark may represent an incipient young species not resolved in the molecular analysis: see discussion of *B. festivella* below). Epilithic species are restricted to siliceous, mostly base-rich rocks; they avoid calcareous substrates like limestone. Substrates were mapped on the species tree to reconstruct the ancestral states. The results imply that most groups (but not Festivella and Psychrophila) originated from epiphytic ancestors (Fig. 3). However, we discuss below the alternative hypothesis that epiphytic lineages are generally derived from epilithic ancestors (see Discussion).

The six larger infraspecific groups also display strong substrate preferences. The Crenularia and Festivella groups prefer inorganic substrates. The Herbidella and Relicta groups are restricted to organic substrates with a preference for tree trunks. The Hungarica group is also restricted to organic substrates, but it prefers twigs of trees and shrubs. All these groups avoid subalpine and alpine habitats. In contrast, the Psychrophila group is variable in substrates but is restricted to cold environments in boreal-montane to arctic-alpine habitats.

3.4 Tethys basin and Macaronesia are plausible evolutionary centers for *Blastenia*

Blastenia is predominantly a genus of the Northern Hemisphere, and the distribution patterns of all six infrageneric groups (Fig. 4) suggest that it always has been. The place of origin of the genus and all its infraspecific groups and a center of their further diversification appears to be the Tethys basin, recently with 6 groups and 17 species in its western remnant, i.e., the Mediterranean basin. Another evolutionary center could be Macaronesia, mainly the Canary Islands and Madeira, with four recent groups and eight species. Two taxa are presumably endemic to Macaronesia (*B. purpurea* and *B. xerothermica* subsp. *macaronesica*) and *B. palmae*, common in Azores, Canary Islands and Madeira, has only a small range outside Macaronesia in coastal areas in the south-western Iberian Peninsula.

High diversity is recorded also in non-Mediterranean Western Eurasia (5 groups and 14 species), but most species have principally a Mediterranean distribution with some occurrences in more northern territories (e.g., *B. coralliza* and *B. ferruginea*). *Blastenia lauri* has principally a Macaronesian distribution, but also has numerous occurrences in the north-western British Isles. The eastern part of Eurasia has four species from only two groups and North America has only three species of two groups (according to present knowledge).

All groups generally avoid the tropics where the exceptional records are restricted to high altitudes (Fig. 5). No confirmed records from the Northern Hemisphere are known south of 28° latitude, except for the specimen from Mt. Elgon, Uganda from 4100 m altitude. In the Southern Hemisphere, records are scarce: the latitudinal range of confirmed records is 67.5°–36.5° plus one record from Madagascar at high altitude (1800 m). All records outside the Mediterranean-Macaronesian diversity hot-spot, and especially those in more distant regions, are fairly scattered, and long-distance dispersal is the most probable origin of distant populations; most of these populations became distinct species (see the Taxonomy part and Fig. 3).

3.5 Species with large geographic ranges and species occurring far from the Mediterranean-Macaronesian center are epiphytic

There are very clear differences in distributions between epilithic and epiphytic species. All epilithic species are centered on Macaronesia and the Mediterranean Basin, though the ranges of a few extend further north, up to the European Arctic, or to the east in an arc from the Baltic Sea coast, through the Carpathians, Crimea, and the Caucasus, to western Iran. All species recorded outside this region (Fig. 4) are epiphytic. The geographical ranges of epiphytic species (e.g., *B. ammiospila*, *B. furfuracea*, and *B. monticola*) are considerably larger than those of even broadly distributed epilithic species (*B. crenularia* and *B. scabrosa*). Epilithic species occurring in alpine or high montane zones of the Mediterranean mountains (*B. caucasica*, *B. gennargentuae*, and *B. psychrophila*) have especially small ranges and do not reach ecologically suitable habitats in the Arctic or in mountains east of the Caucasus.

3.6 Within-species genetic variation is low in widely distributed species but high in epilithic species with Mediterranean-Macaronesian distribution

The number of polymorphic nucleotide positions within species is 0–11 in mtLSU, 0–63 in beta-tubulin, 4–85 in ITS, and 5–159 in the whole dataset (Table 3). Species with large a geographical range (especially the epiphytic *B. ammiospila*, *B. furfuracea*, *B. monticola* and epilithic *B. scabrosa*) have rather low genetic variation. On the contrary, *B. gennargentuae*

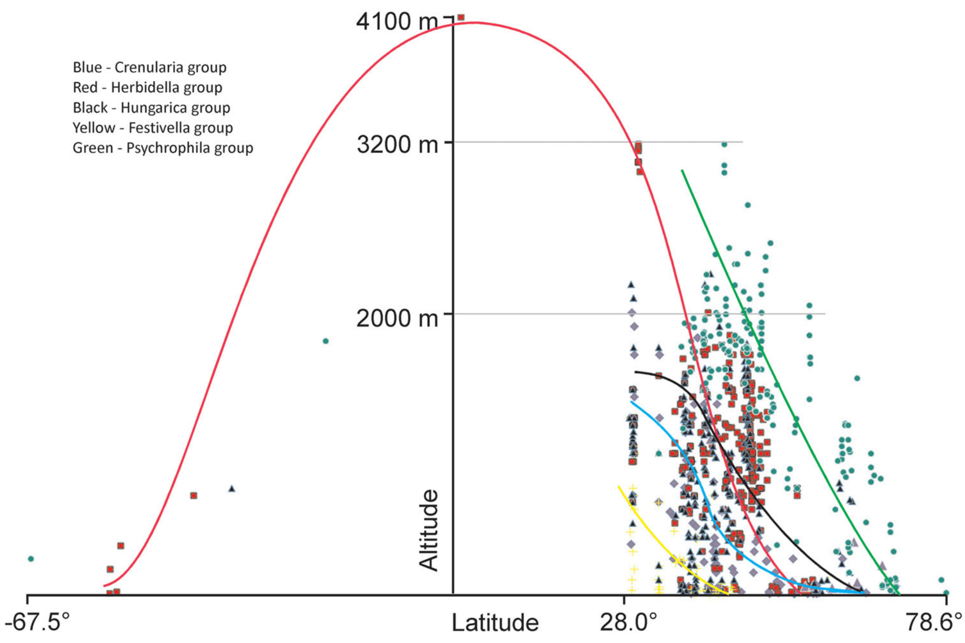


Fig. 5. World latitude / altitude range of the infrageneric *Blastenia* groups (legend in the picture). Trend curves interposed by hand.

sampled in a very small part of the Mediterranean region has surprisingly high genetic diversity; ITS sequences obtained from three co-occurring thalli varied among each other in 12 nucleotide positions. Another epilithic species with Mediterranean-Macaronesian distribution, *B. festivella*, has distinctly higher overall genetic variation (159 polymorphic sites) than the other species (5–86). High variation in beta-tubulin within *B. herbidella* and *B. xerothermica* is caused by the diversity between the two infraspecific taxa in both species (Table 3). High variation within the few available sequences of *B. catalinae* and *B. circumpolaris* is probably caused by the existence of two putative species within each (see the ITS tree in Fig. 1 and details for *B. catalinae* in the Taxonomy part).

3.7 Chemical differentiation in apothecia: Ancestral chlorination of anthraquinones and secondary reductions

Three chemotypes occur in *Blastenia*. The first and most common chemotype contains nonchlorinated parietin and a small proportion of its oxidation products teloschistin, fallacinal and parietinic acid, and emodin in the hymenium (chemosyndrome A of Søchting, 1997), whereas the excipulum is dominated by chlorination products of emodin and its oxidation products: 7-chloroemodin, 7-chlorocitreorosein, 7-chloroemodinal, and 7-chloroemodic acid (chemosyndrome C of Søchting, 2001). Small amounts of fragilin are occasionally detected. This chemotype is also found in the phylogenetic outgroup *Caloplaca fuscorufa*. Accordingly, this chemotype can be regarded as basal in *Blastenia* (Fig. 3).

In the second chemotype, the nonchlorinated parietin persists in all apothecial parts, but the ability to chlorinate other anthraquinones is secondarily reduced (Fig. 6). This chemotype evolved in the Hungarica group and is always present in *B. hungarica*, *B. palmae*, and *B. xerothermica*.

The third chemotype is characterized by chlorinated anthraquinones in all apothecial parts and usually by reduced production of parietin (Fig. 6). This evolved independently in the Crenularia, Hungarica and Psychrophila groups. It is always present in *B. ammiospila*, *B. purpurea* and *B. subathallina* and it is occasional in *B. catalinae* and *B. caucasica*. Parietin is not always reduced; it is absent to present in abundance in *B. ammiospila*.

These three chemotypes can be detected using UPLC chromatograms in UV light and TLC (Fig. 6). However, mass spectrometry (a more sensitive method) also detected most of the anthraquinones reported by Søchting (2001) in all analyzed samples (see Table S3). In specimens with the nonchlorinated anthraquinone chemotype, chlorinated anthraquinones were detected (though usually only in small amounts) and vice-versa. This means that lichens with reduced accumulation of chlorinated or nonchlorinated anthraquinones did not entirely lose these substances.

3.8 Reduction in apothecial size is connected with substrate shift to twigs

Most *Blastenia* species have rather large apothecia (compared to other microlichens), ca. 0.7–1.2 mm in diameter. Some species, however, have distinctly smaller apothecia, consistently small in all sampled specimens. The Hungarica group only includes lichens with small apothecia, ca. 0.3–0.7 mm in diameter. Reduction of apothecial size in the group reflects the preference for growing on twigs of trees and shrubs where 180 of 248 specimens were recorded (more in Table 4). Small apothecial sizes also occur in the other 68 specimens growing on the bark of trunks and on wood. This implies that smaller apothecia evolved as an adaptation to limited space on twigs, but the character is fixed even in specimens on tree trunks. Epiphytic *B. afroalpina*, *B. catalinae*, and *B. herbidella* subsp. *acidophila* also have small apothecia and are mostly known from twigs. The other 11 epiphytic species have distinctly larger apothecia and occur mainly on the bark of tree trunks (Table 4).

3.9 Vegetative diaspores are a derived character in *Blastenia* linked to the reduction of ascospore size

All 24 *Blastenia* species produce apothecia, and 7 of them also produce vegetative diaspores. Ancestral state mapping supports the hypothesis that vegetative diaspores formed as a secondary character in *Blastenia* (Fig. 3). According to the available data, we suggest at least five independent origins of vegetative reproduction during the diversification of *Blastenia*. Vegetative diaspores, mostly isidia or blastidia (soralia are present only in *B. circumpolaris*), are present only in the Herbidella and Psychrophila groups, but their occurrence in these groups is substantial. Within the Herbidella group, three of six species have vegetative diaspores. These species produce vegetative diaspores in most observed specimens, but a few thalli were completely or mainly without them (*B. coralliza* Malíček 5561; Andalusia). In the Psychrophila group, four of eight species have vegetative diaspores (observed in all specimens studied).

There is a clear tendency for ascospore size to be smaller in species with vegetative diaspores. The mean ascospore length in species without vegetative diaspores is 14.0 μm, but only 12.9 μm in species with them ($n = 590/n = 263$). The difference is even more significant within the groups, such as 15.1/12.8 μm ($n = 110/63$) in the Herbidella group and 15.5/12.9 μm ($n = 106/200$) in the Psychrophila group. The volume of acospores in species with vegetative diaspores is reduced by about 40% in both groups.

3.10 Genome sizes are higher in epilithic species

Measurements of GS were attempted in all species (Fig. S1; Table S2), but measurements failed in *B. remota* and measurements in *B. afroalpina* are not reliable (see the Methods for age-induced genomic changes). The measured GSs ranged between ca. 22–35 Mb. Genome size variations within the infrageneric groups were slightly smaller (Fig. 7). We evaluated infraspecies variability in GS in two species, *B. crenularia* (in 10 specimens) and *B. festivella* (7) and we found variability in both species that slightly exceeded measurement error: 28.6–35.7 Mb in *B. crenularia* and 30.1–34.5 Mb in *B. festivella*.

Our data revealed the reduction in the genome linked with occurrence on organic substrates ($P < 0.001$; tested by Mann–Whitney). This trend is even stronger within particular groups. For instance, in the Crenularia group, epiphytic *B. catalinae* has smaller GS (28.9 Mb) than its epilithic relatives (32.7–35.7 Mb), or in the Psychrophila group, epiphytic *B. ammiospila* (27 Mb) has smaller genome than its sister

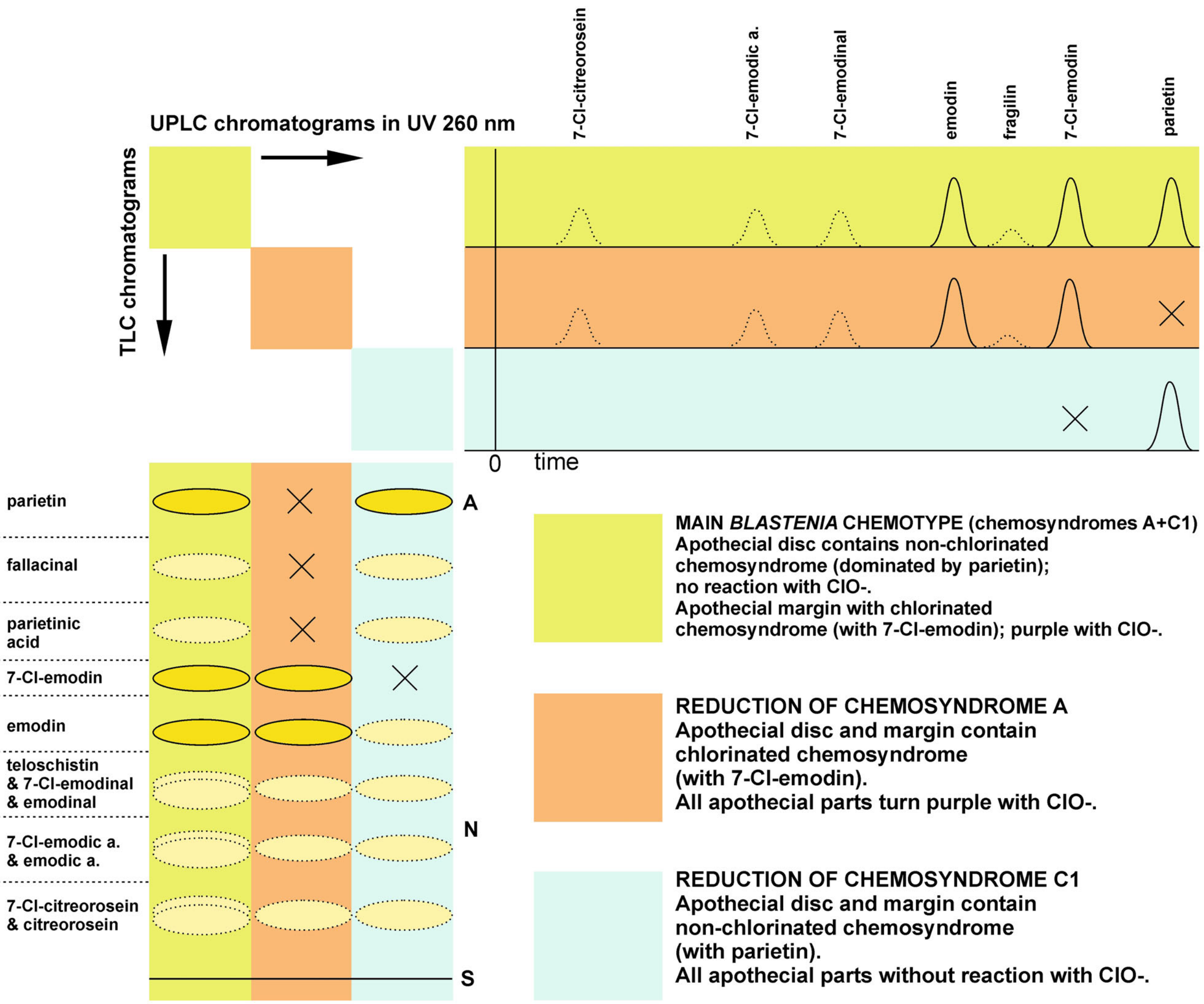


Fig. 6. Chemistry of apothecia in *Blastenia*. Differences among three known chemotypes are demonstrated. On the left: schematic TLC chromatograms (solvent system C; abbreviations: A, atranorin; N, norstictic acid; S, starting line). On top right: UPLC chromatograms in UV 260 nm. Major substances indicated by full line, minor substances by dotted line. Black crosses indicate diagnostic absences of the substances. Examples of the three *Blastenia* chemotypes represented by distinct colours. ClO- is a hypochlorine ion present in chlorine detergents routinely used for identification of some lichen substances.

epilithic species, *B. scabrosa* (33 Mb). Nevertheless, we found some deviation from this rule; the epiphytic *B. xerothermica* has the large GS typical of epilithic species and the epilithic *B. psychrophila* has an unexpectedly small genome.

We did not find any significant correlations between GS and the following morphological traits: ascospore length, apothecium diameter and vegetative reproduction. Specimens from xerothermic conditions tend to have a larger genome than those from cold and humid conditions, but the trend is not significant.

4 Discussion

4.1 Effect of limited sampling

The collections available to us are heavily biased towards Europe and North-western Asia, and those from other regions have a rather random character. We strongly suspect that there remain undiscovered species, especially in those other regions. In addition to several species recognized in the Southern hemisphere, we examined a specimen close to *Blastenia monticola* from Madagascar (herb. Halda 0968) and a specimen similar to *B. hungarica* from Chile (herb. Etayo 24477b). Both specimens probably represent well delimited *Blastenia* species, but we did not obtain a full three-loci DNA dataset for them and we prefer not to describe them as new here. We also expect one species in the Caribbean; see the comment on Wetmore (1996) in the taxonomy section below *B. crenularia*. There may be additional species even in well-surveyed areas of Europe and North-western Asia. For example, we recently sequenced a specimen collected by Roman Türk in Austria that is similar to *B. ferruginea*, but its ITS barcode sequence placed the specimen in an uncertain position within *Blastenia*.

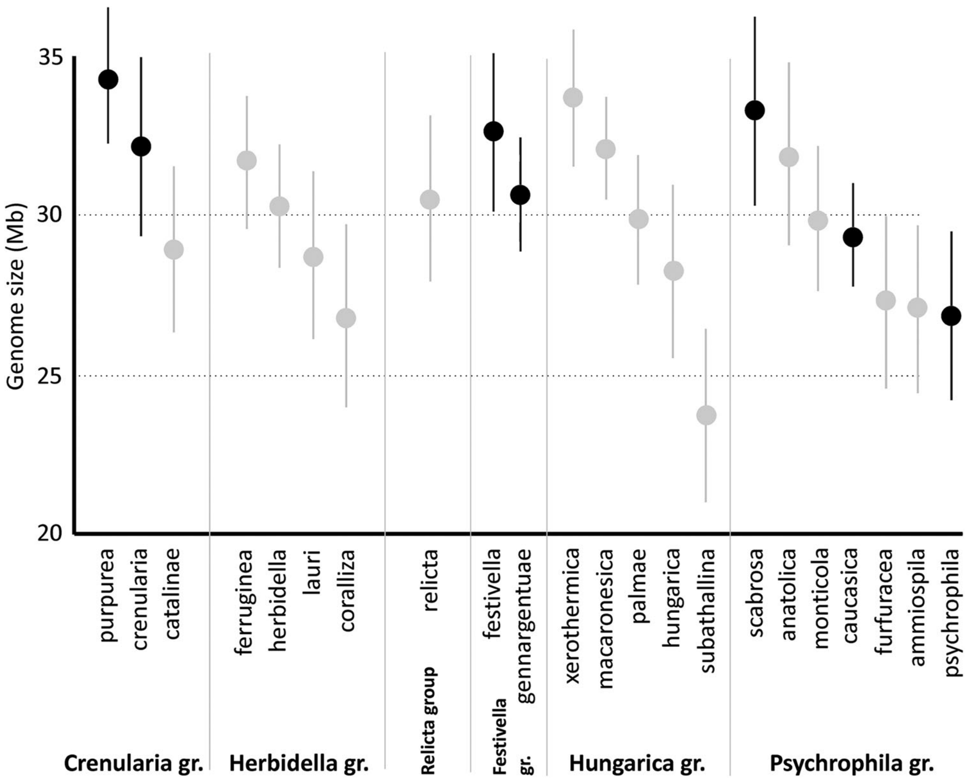


Fig. 7. Genome sizes in *Blastenia*; mean+/−CV. Black symbols represent epilithic lichens; grey symbols are epiphytic. Taxa are divided into the six infrageneric groups. Within each group, taxa are arranged from highest to lowest genome size. Fluorescence intensity histograms are available in Fig. S1.

It does appear that some regions outside Europe and North-western Asia are genuinely poor in *Blastenia*. We expect few (if any) overlooked species in the North American coastal areas surveyed by Arup or in the southern part of South America and Subantarctic regions surveyed by Søchting. Recently we made field trips to sample Teloschistaceae, including *Blastenia* to southern Siberia, eastern China, USA and Chile. Those regions proved to be poor in *Blastenia*. Specimens collected from southern Africa, Australia and New Zealand that resemble *Blastenia* morphologically turned out to belong to the genus *Eilifdahlia* according to ITS sequence data. Our failure to find large numbers of *Blastenia* in areas outside western Eurasia implies that our conclusion that all infrageneric groups are geographically centered in the Mediterranean basin and Macaronesia is robust. It cannot be dismissed as an artifact of inadequate sampling.

4.2 Ecological and geographical constraints

In comparison to some large genera of Teloschistaceae that are mostly restricted to inorganic substrates (e.g., *Flavoplaca*, *Pyrenodesmia*, *Rufoplaca*, *Xanthocarpia*), *Blastenia* occupies a large spectrum of niches. Its species occur in various epiphytic and epilithic communities in cold to warm regions of the temperate zone. However, there are some gaps, and no *Blastenia* species occur on calcareous substrates, even though those substrates are usually rich in Teloschistaceae. *Blastenia* is also absent from dry continental regions which support other genera of Teloschistaceae (e.g., *Calogaya*, *Xanthocarpia*). These two constraints suggest that *Blastenia* originated in an area without limestone rocks and with a rather oceanic climate. The Canarian and Madeira archipelagos are a contemporary instance of the kind of region in which we consider *Blastenia* to have originated, though the actual region of origin was probably further east in the Tethys basin, as those archipelagos are considered to be younger than *Blastenia*.

We are astonished by the limited distribution ranges of epilithic species: they are almost confined to Mediterranean areas and Macaronesia. Only a few species reached more northern inland sites. *Blastenia crenularia* also reached coastal areas in Scandinavia and Iceland and the blastidiate *B. scabrosa* also reached some arctic areas. The limited dispersal abilities in epilithic populations may be caused in part by the low availability of suitable substrates (mostly base-rich siliceous rocks), but in addition to that most species are rare and have specialised requirements, e.g., spots with basic siliceous rocks in the humid alpine zone (Psychrophila group), or coastal rocks in a mild oceanic climate (*B. festivella*). For such species, the large continental areas of Eurasia would have presented a major obstacle to dispersion.

On the other hand, some epiphytic species form large populations in forested areas (e.g., *B. coralliza* and *B. herbidella*) and represent a significant source of diaspores for short and long-distance dispersal. As a result, at least three epiphytic species occur in and presumably originated in very distant regions, even in the Southern Hemisphere. An abundance of suitable habitats also allowed *B. furfuracea* and *B. monticola* to spread widely in boreal-montane forests of the Northern Hemisphere. *Blastenia ammiospila*, which occurs on various organic substrates, does even better: it is circumpolar in the Northern Hemisphere and also occurs in the Antarctic.

Our conclusions about epilithic species in *Blastenia* having more restricted geographical ranges cannot be generalized to all lichens. It is valid for some genera (e.g., Tehler et al., 2013), but numerous epilithic lichens have large geographic ranges and some are considered cosmopolitan (e.g., Quilhot et al., 2007). It is probably not even true for all of Teloschistaceae; for example, the epilithic *Flavoplaca flavocitrina* may be cosmopolitan (Vondrák et al., 2016), and *Xanthomendoza borealis* is bipolar (Lindblom & Søchting, 2008).

4.3 Repeated switches from inorganic to organic substrates

If Gaya et al. (2015) are correct in suggesting an ancient shift from organic substrates to inorganic in the early evolution of Teloschistaceae, then the shift back to organic substrates had to occur repeatedly, because both epilithic and epiphytic species are present in most larger genera of Teloschistaceae including *Blastenia*. Ancestral substrate state mapping supported the scenario that *Blastenia* had an epiphytic ancestor (only 28% probability for the epilithic state, Fig. 3) and few subsequent switches to inorganic substrates. There are however good reasons for supposing an epilithic ancestor and repeated switches to organic substrates, as follows: (i) Most genera of Teloschistaceae close to *Blastenia* are exclusively or predominantly, epilithic. The only exception is the small genus *Bryoplaca* (Arup et al., 2013). (ii) Six epiphytic lineages, but no epilithic lineages, originated in regions distant from the Mediterranean-Macaronesian diversification center (red crosses in Fig. 3). (iii) All species of the epiphytic Hungarica group of *Blastenia* share a specific chemotype not found elsewhere in *Blastenia* (Figs. 3, 6), reduced apothecia and a strong preference for occurrence on twigs. This Hungarica phenotype is not found elsewhere in *Blastenia* and appears to be an apomorphic evolutionary innovation associated with a major evolutionary event, probably a substrate switch from an epilithic ancestor (see the results). (iv) We observed a local epiphytic population within the large epilithic population of *B. festivella*. Although not recognized within the molecular analysis, this population may be an incipient species following a substrate switch (see *B. festivella* below). We thus have contemporary evidence that epilithic to epiphytic switches can occur in *Blastenia*, but none for switches in the opposite direction. (v) Epilithic species of *Blastenia* tend to have greater genetic variation than the epiphytic ones, suggesting that they are older. The two species with the largest within-species genetic variation in *Blastenia*, *B. festivella* and *B. gennargentuae* are both epilithic (Table 3).

The topic of substrate switches in lichens has been little studied, but Otálora et al. (2013), on the basis of ancestral state mapping, suggested that the ancestral state of Collemataceae was epilithic, although today the family has numerous epiphytic species. Lücking et al. (2013) concluded that the ancestor of Redonographoideae (a subfamily of Graphidaceae) was epilithic, though today there are species on both organic and inorganic substrata. For Graphidaceae itself, they suggested an epiphytic ancestor. This parallels our own situation: *Blastenia* (epilithic ancestor) within Teloschistaceae (epiphytic ancestor).

4.4 Reduced genome in epiphytic species

The smaller GS in epiphytic *Blastenia* is probably caused by secondary reduction. Mohanta & Bae (2015) report the average GS in Ascomycota to be 36.91 Mb which is greater than most measurements in *Blastenia*. Within Teloschistales, only *Xanthoria parietina* with 31.9 and 40 Mb is included in the Fungal genome size database (Kullman et al., 2005). Most measurements of epilithic *Blastenia* are also within this range, but numerous epiphytic *Blastenia* species have GS below 30 Mb (Fig. 7). Although evolution most commonly increases GS, examples of reduction are also known and its mechanisms have been described (Yuen et al., 2003; Gregory, 2005). Correlations between GS and a variety of physiological, morphological, and ecological traits are well established in a broad range of organisms. In fungi, genomic changes connected with ecological transitions have been revealed by genome sequencing (Ma et al., 2010; Spanu et al., 2010) and thus a change in GS could be an adaptation to ecological switch.

In *Blastenia*, the usual pattern is a small genome in epiphytic species and a larger one in epilithic species, but there are exceptions: the epiphytic *B. xerothermica* has a large genome and the epilithic *B. psychrophila* a small genome. Several abiotic factors are known to influence GS in plants (Wakamiya et al., 1993; Knight & Ackerly, 2002) which could indicate that other selection pressures played a role in GS evolution of *Blastenia*. For example, we found that species living in xerothermic condition tend to have larger GS (mean 33.5 Mb) than species living in a cold environment (mean 29.1 Mb) or a humid one (mean 30 Mb).

4.5 Vegetative diaspores are secondary in *Blastenia*

Purely asexual lineages are rare in Teloschistaceae (Vondrák et al., 2016) and are absent from *Blastenia*. However 29% of *Blastenia* species (7 out of 24; 6 epiphytic, 1 epilithic) form vegetative diaspores. Based on ancestral character state mapping in numerous lichen phylogenies, Tripp (2016) concluded that lineages forming vegetative diaspores sometimes represent a source for evolutionary innovation. According to our data, this is not the case in *Blastenia*. Mapping of ancestral character states in *Blastenia* indicated only a low probability of vegetative diaspores (<30%) in most nodes (Fig. 3). Furthermore, these lineages were found only in two of the six infrageneric groups. Secondary losses of vegetative diaspores are only possible in the Psychrophila group (Fig. 3). However, the species with vegetative diaspores (apart from *B. monticola*) appear to be younger than the other species in the Psychrophila group, because their variability in genotype is distinctly lower (Table 3).

5 Taxonomy

5.1 Notes

1. We propose a hierarchic taxonomy employing three levels. (i) Infrageneric groups are taxa recognized in the backbone structure of the phylogenetic trees that have their own phenotype characteristics. We prefer not to

give them formal taxonomic rank because *Blastenia* is a small genus and morphologically rather uniform. (ii) Species are recognized as clades resolved in the concatenated tree that are supported by the species delimitation test (BP&P), and that form phenotypically circumscribed groups. (iii) Subspecies are used for taxa that are resolved in only one or two single-loci phylogenies and that are semicryptic (sensu Vondrák et al., 2009), meaning not morphologically recognizable, but with distinct ecology or distribution.

2. The generic description below is intentionally long and we describe there all the characters that are either invariable within the genus or variable but the variability pattern is not diagnostic for any species. Descriptions of species are deliberately short because most species in *Blastenia* differ little in morphology. Geographical ranges, ecology or chemistry are usually more important for species identifications.
3. Presence/absence of chlorinated anthraquinones in particular apothecial tissues is a valuable character in *Blastenia* taxonomy. The spot reaction with hypochlorite ion ("C") is a helpful character reflecting the presence (C+ purple) or absence (C–) of chlorinated anthraquinones (Vondrák et al., 2013a). When using C-reaction, care must be taken to use the correct concentration. Chlorinated detergents bought in drugstores are often strongly concentrated and cause a C+ red spot reaction even on samples without chlorinated anthraquinones. Therefore, we strongly recommend testing the negative reaction on apothecia of the common *Xanthoria* or *Rusavskia* species, which never have chlorinated anthraquinones. The concentration of the C-solution must be reduced until it does not cause a red reaction on the apothecial discs of *Xanthoria* or *Rusavskia*.
4. Only type specimens are provided with the details in the text. Other investigated specimens are listed in Table S1.

5.2 Genus description

Morphology: Thallus crustose, areolate, variable in size and shape, round or irregular, sometimes several centimeters in diameter, but sometimes reduced to small areas around apothecia or almost disappearing; varying within each species. The thallus is usually without anthraquinones and color ranges from white to dark grey (grey tinge caused by the pigment Cinereorufa-green; details in Meyer & Printzen, 2000). Some species (mostly those with vegetative diaspores) with partly or completely yellow thallus contain anthraquinones; the presence and amount of anthraquinones in thallus is variable and varies among specimens within each species. Prothallus may be present in all species (most pronounced in the contact zone with surrounding lichen thalli), black, formed by hyphae melanized by Cinereorufa-green; its extent is very variable within most species. In some species, the prothallus is also visible among dispersed areoles, and forms a black hypothallus in *B. gennargentuae*. Thallus areoles are usually flat, but older areoles may be convex or with an uneven upper surface, giving thalli a scabrose appearance. Thallus thickness is variable, but thalli are generally thin, up to 150 μm, only crusts with dense vegetative diaspores appear to be thicker owing to heights of the diaspores. Epiphytic species forming endophloedal or thin epiphloedal thallus are usually less than 100 μm thick; epilithic species may have slightly thicker thallus, exceeding 100 μm in older areoles. Some species have vegetative diaspores (soredia, blastidia, isidia); their presence, shape and size are often species specific. Cortex is not developed (except for cortex of thalline exciple, see below); alveolate cortex sometimes developed, but usually inconspicuous. Epinecral layer often present, but very thin (usually <10 μm), without clear borderline with alveolate cortex. Algal layer continuous (mostly <100 μm thick) or discontinuous, forming irregular cushions (ca. 50–100 μm diam.) surrounded by a loose fungal tissue defined as either algonecral medulla (in the lower part of thallus) or alveolated cortex (in the upper part). Medulla absent or thin, observable in thick epilithic thalli.

Apothecia usually large (often >1 mm diam.), but in some species, apothecia are consistently small, not exceeding 0.5 mm. Young apothecia are slightly concave to flat, later remaining flat or becoming slightly convex. Mature apothecia are sessile, sometimes with constricted base. Colour of apothecia varies from pale orange to dark red; paler apothecia are in species without chlorinated anthraquinones. Apothecial margin (true exciple) has the same colour or is paler than the disc. Old or injured apothecia sometimes turn black (anthraquinones are replaced by Cinereorufa-green). The apothecial disc is usually roughened by anthraquinone crystals (epipsamma). Apothecia biatorine or zeorine, both types are present in most species, sometimes in a single specimen. Apothecial margin consists of a true exciple and (in zeorine apothecia) also a thalline exciple. True exciple is usually thin (up to 100 μm), the same color as the disc, or darker. It is prosoplectenchymatous, often clearly divided into an upper part (fan-shaped true exciple) and a lower part (initial cortex; see below). Fan-shaped true exciple is formed of thin-walled radiating hyphae becoming shortened and broadened towards the surface, superficial cells up to 5 μm wide. Cortex part formed of palisade prosenchyma of ±equally wide (ca. 3–5 μm) inner and outer cells, but hyphae in this tissue have sometimes very thin lumina and glutinized walls (both glutinized and non-glutinized tissues are found within some species). Clusters of algal cells are sometimes located between the fan-shaped exciple and the initial cortex.These clusters are small and occasional in young apothecia, but they sometimes expand and turn into thalline exciple in old apothecia (This is demonstrated for *B. herbidella* by Poelt & Wunder 1967: fig. 2). In some old apothecia, the lower part of the true exciple (initial cortex) changes into the cortex (usually up to ca. 30 μm thick) at the lower part of the thalline exciple. Hypothecium (together with subhymenium) is prosoplectenchymatous, up to ca. 150 μm thick in the axial part of apothecia. Subhymenium containing ascogenous and paraphysogenous hyphae is sometimes distinct from the hypothecium by irregularly thickened cells and by the amyloid, I+ blue reaction (lower hypothecium and true exciple are nonamyloid, I–). Hypothecium and inner true exciple are often partly yellowish or brownish, K-, N+ orange. Hypothecium is usually at least slightly inspersed and ca. 60–120 μm high. Hymenium 70–100 μm tall, not inspersed in most species, but sometimes inspersed in *B. crenularia*. Paraphyses are 1.5–2 μm wide in the lower part, widened to 2.5–5.5 μm in tips; sometimes branched and anastomosed; glutinized, partly glutinized or not glutinized (variable within species). Asci usually 50–70 × 12–22 μm; their size varies with the development stage, and number and size of ascospores inside. Ascospores polarilocular, usually ellipsoid (rarely narrowly ellipsoid or subspherical or indistinctly rhomboid), ca. 10–20 × 5–10 μm, length/width ratio ranges 1.3–2.3; with broad equatorial thickenings of the wall (4–8 μm); usually 8 spores in asci, but 4 or 6 spores occasionally observed in mature asci in most species.

Pycnidia frequent or rare (depending on species), usually forming low projections on thallus, but sometimes fully immersed; their size is very variable, even in a single specimen (ca. 50–200 μm diam.). Pycnidial tops are usually red or orange, with chlorinated anthraquinoes (C+ purple); less frequently, dark-grey or blackish, containing Cinereorufa-green. Well developed pycnidia multi-chambered (*Xanthoria*-type sensu Vobis, 1980). Conidia bacilliform, rarely narrowly ellipsoid, ca. 3–5 × 1–1.5 μm; differences among species not observed.

Chemistry: Two anthraquinone chemosyndromes may be present: (i) Nonchlorinated chemosyndrome with parietin (dominant), emodin, fallacinal, parietinic acid and teloschistin (chemosyndrome A of Søchting, 1997); (ii) chlorinated chemosyndrome with 7-Cl- emodin (dominant), emodin, 7-Cl-citreorosein and 7-Cl-emodinal (chemosyndrome C1 of Søchting, 2001). Some species specifically contain only one of the two syndromes, either chlorinated or nonchlorinated (Fig. 6), while others have a combination of the two (referring to chemosyndromes C3 and C4 of Søchting, 2001). In the latter group, chlorinated anthraquinones predominate in apothecial margins, while non-chlorinated in apothecial discs (Fig. 6). Cinereorufa-green (green-grey pigment; K−, N+ violet in section) is present in all species, but hardly detectable in some specimens. Sedifolia-grey, contained in some species similar to *Blastenia*, is absent.

Ecology & Geography: See Table 4; Figs. 4, 5.

Key diagnostic characters: Thallus crustose, without marginal lobes, usually in some shade of grey, rarely yellow. Apothecia orange to rusty red. Ascospores ellipsoid with thick equatorial thickenings of the wall. Pycnidia mostly red, with anthraquinones. Conidia bacilliform to narowly ellipsoid. Chlorinated anthraquinones (C+ purple) usually restricted to the apothecial margin. Cinereorufa-green (K−) in darkened parts of thallus and apothecia. Table 5 shows differences from similar genera or species of Teloschistaceae.

Images: Photographs of all recognized species and subspecies are at http://botanika.prf.jcu.cz/lichenology/index.php?pg=5&func=cat&idx=32#photos.

5.3 Infrageneric groups

5.3.1 Crenularia group

Species: *B. catalinae*, *B. crenularia*, *B. purpurea*.

Morphology: Vegetative diaspores absent; thallus grey, up to 100 μm thick in epiphytic *B. catalinae*, but occasionally thicker in older convex areoles of epilithic species; apothecia orange-red to dark red, on average 0.8–1 mm diam., but smaller in the epiphytic species; hymenium not inspersed (like in other groups within *Blastenia*) or inspersed (sometimes in *B. crenularia*); pycnidia red, with anthraquinones.

Chemistry: Nonchlorinated anthraquinones in the apothecial disc, chlorinated anthraquinones in exciple (*B. crenularia* and part of *B. catalinae*) or chlorinated anthraquinones in whole apothecia (*B. purpurea* and part of *B. catalinae*). Thallus with Cinereorufa-green, but only traces may be detectable in the epiphytic species. Anthraquinones not detected in the thallus.

Ecology: epilithic or epiphytic (only *B. catalinae*); preferring warm temperate climate.

Geography: Centred in the Mediterranean basin and Macaronesia (*B. crenularia* and *B. purpurea*) and western North America (*B. catalinae*) (Fig. 4).

Genome size: Variable; 28.9–35.7 Mb (Fig. 7).

Phylogeny: The group is strongly supported in the analysis of the concatenated dataset, with the Herbidella group as a sister clade (Figs. 2, 3); it is monophyletic also in Beta-tubulin and mtLSU phylogenies, but it is unresolved in ITS (Fig. 2).

5.3.2 Festivella group

Species: *B. festivella*, *B. gennargentuae*.

Morphology: Vegetative diaspores absent; thallus grey, never yellow; young areoles flat, up to 150 μm thick, but old areoles becoming convex to bullate or with uneven upper surface, up to 800 μm thick; black prothallus distinct, forming lines delimiting thalli; apothecia pale to dark red, on average 0.7–1.1 mm diam.; hymenium not inspersed; pycnidia black, with Cinereorufa-green, but red pycnidia with anthraquinones are sometimes present in *B. festivella*.

Chemistry: Nonchlorinated anthraquinones in apothecial disc, chlorinated anthraquinones in exciple. Cinereorufa-green forms black color of distinct prothallus and hypothallus and sometimes it causes blackening of apothecia. Anthraquinones not detected in the thallus.

Ecology: Epilithic on siliceous rocks.

Geography: Mediterranean-Macaronesian distribution.

Genome size: 30.6–35.2 Mb (Fig. 7).

Phylogeny: Two species included in this group do not have any close relatives (Figs. 2, 3). They do not form a common monophyletic group in any analysis, but it is convenient to put them together for purposes of discussion, because of their similar phenotype.

5.3.3 Herbidella group

Species: *B. afroalpina*, *B. circumpolaris*, *B. coralliza*, *B. ferruginea*, *B. lauri*, *B. herbidella*, *B. remota*.

Morphology: Vegetative diaspores (isidia, blastidia and rarely soralia) present in three of seven species; thallus usually pale to medium grey, but occasionally yellow to orange, thin, mostly <100 μm thick; apothecia orange-red to dark red, in average 0.7–1 mm diam., but smaller in some species (e.g., *B. afroalpina*); hymenium not inspersed; pycnidia red, with anthraquinones.

Chemistry: Nonchlorinated anthraquinones in apothecial disc, chlorinated anthraquinones in exciple (all species). Cinereorufa-green occasionally in thallus, but only in traces, mostly in prothallus, sometimes in tips of blastidia. Anthraquinones sometimes present in thallus (occasionally observed in five of eight species).

Ecology: Always epiphytic; usually on tree trunks, some species specialized to twigs; preferring forests in a humid temperate climate.

Geography: Centred in the Mediterranean basin (three species) and Macaronesia (two species) with scattered

Table 5 Differences between *Blastenia* and the most similar Teloschistaceae

Taxon	Differences from *Blastenia*	References
Bryoplaca sinapisperma	Resembling *B. ammiospila* in its occurrence on bryophytes and plant debris and by chlorinated anthraquinones in whole apothecial surface. Differing in convex apothecia of brownish tinge and by substantial amount of atranorin in thallus.	Søchting et al., 2008; Arup et al., 2013
Eilifdahlia	Distributed in Southern Hemisphere. No marked phenotypic differences from *Blastenia*.	Kondratyuk et al., 2009b, 2014, 2017
Gyalolechia	Melanisation by Cinereorufa-green not observed. Thallus usually yellow, containing substantial amount of fragilin.	Arup et al., 2013; Vondrák et al., 2016
Huneckia	Whole apothecial surface C+ purple, i.e., chlorinated anthraquinones not restricted to only apothecial margin. Main anthraquinones: chrysophanol, chrysophanal and rhein.	Kondratyuk et al., 2014
Rufoplaca	Distinguished by narow ascospores with narow septa. Chlorinated anthraquinones absent. Melanisation by Sedifolia-grey (K+ violet). Cinereorufa-green absent.	Arup et al., 2013
Caloplaca xerica group (including e.g., *C. fuscoatroides*, *C. erythrocarpa,* and *C. neotaurica*)	Whole apothecial surface C+ purple, i.e., chlorinated anthraquinones not restricted to only apothecial margin. Melanisation by Sedifolia-grey (K+ violet). Cinereorufa-green absent.	Vondrák et al., 2012
Caloplaca caesiorufella/*C. spitsbergensis*	Morphology and ecology similar to *B. ammiospila.* Slight differences in apothecia and spores reported, but not always sufficient for reliable identification.	Søchting et al., 2008
Caloplaca fuscorufa	Hardly distinguished from morphologically and ecologically similar *B. psychrophila*, but often more melanized in apothecia. No marked differences from *Blastenia*.	Arup et al., 2007
Caloplaca leptocheila	Morphologically and ecologically similar to *B. psychrophila*, but thallus hardly developed and chlorinated anthraquinones in whole apothecial surface.	Magnusson, 1944b

records northwards up to Northern Scandinavia; *B. circumpolaris* is broadly distributed in temperate zone of Southern Hemisphere; other taxa are restricted to small areas in Ural Mts. (*B. herbidella* subsp. *acidophila*), Himalayas (*B. remota*), and mountains in tropical Africa (*B. afroalpina*).

Genome size: Variable; 26.8–32.7 Mb.

Phylogeny: The group is supported in the concatenated tree and the *BEAST tree, with the Crenularia group as a sister clade (Figs. 2, 3); it is monophyletic in mtLSU single-gene phylogeny, but unresolved by Beta-tubulin and ITS (Fig. 1).

5.3.4 Hungarica group

Species: *B. hungarica*, *B. palmae*, *B. subathallina*, *B. xerothermica*.

Morphology: Vegetative diaspores absent; thallus grey, thin, mostly <100 µm thick; apothecia orange-red (usually paler than in other groups), reduced in size, on average 0.3–0.7 mm diam.; hymenium not inspersed; pycnidia grey with Cinereorufa-green, inconspicuous.

Chemistry: Apothecial disc and exciple with predominated nonchlorinated anthraquinones (three species) or chlorinated anthraquinones (*B. subathallina*). Cinereorufa-green present in thallus (and in injured apothecia), but sometimes only in traces. Anthraquinones absent in thallus.

Ecology: Always epiphytic; usually on twigs, but sometimes on tree trunks; in warm temperate to boreal-montane forests or in Mediterranean scrublands.

Geography: Mediterranean basin and Macaronesia with occurrences northwards up to Northern Scandinavia; one undescribed species related to *B. hungarica* occurs in Chile.

Genome size: Variable; 21.6–34.1 Mb (Fig. 7).

Phylogeny: The group is strongly supported in the concatenated tree (Fig. 2) and the *BEAST species tree (Fig. 3) and is related to Festivella and Psychrophila groups. It is monophyletic in Beta-tubulin single-gene phylogeny, but it is divided into two supported clades in mtLSU where *B. xerothermica* does not group with the rest of species. The group is unresolved in ITS (Fig. 1).

5.3.5 Psychrophila group

Species: *B. ammiospila*, *B. anatolica*, *B. caucasica*, *B. furfuracea*, *B. monticola*, *B. psychrophila*, *B. scabrosa*.

Morphology: Vegetative diaspores (isidia, blastidia) are present in four of eight species; thallus grey, or sometimes yellow (more frequently in epiphytic species); young areoles flat, up to 150 µm thick, but old areoles of epilithic species becoming convex to bullate or with uneven upper surface, up to 500 µm thick; apothecia pale to dark red, on average 0.7–1.2 mm diam.; hymenium not inspersed; pycnidia red with anthraquinones.

Chemistry: Nonchlorinated anthraquinones in the apothecial disc, chlorinated anthraquinones in exciple (most species) or chlorinated anthraquinones in both disc and apothecial exciple (*B. ammiospila* and rarely in *B. caucasica*). Cinereorufa-green present in thallus (and in some old and injured apothecia), but sometimes only in traces. Anthraquinones occasionally present in the thallus of epiphytic species, but very rarely in epilithic species.

Ecology: Epilithic (three species) or on organic substrata (four species); psychrophilous; preferring boreal-montane to arctic-alpine habitats.

Geography: In mountains of temperate zone and in arctic and boreal zone of Northern Hemisphere (Fig. 4); diversity is concentrated in mountains in Mediterranean regions (seven of eight species); absent from Macaronesia; scattered in Southern Hemisphere: in Antarctica (*B. ammiospila*) and an undescribed species in mountains of Madagascar.

Genome size: Variable; 26.9–33.3 Mb (Fig. 7).

Phylogeny: The group is supported in the concatenated tree (Fig. 2) and the*BEAST species tree (Fig. 3) and is related to Festivella and Hungarica groups. It is poorly resolved in the single-gene trees, i.e., it forms a group with low support (Fig. 1). It is the youngest group within *Blastenia*, dated to 4.5–2 Mya.

5.3.6 Relicta group

Species: only *B. relicta* (described below).

Phylogeny: The group is supported in the concatenated tree and also in single-gene trees (Figs. 1, 2). Its position in *Blastenia* phylogeny is unsettled; whereas it is related to Crenularia and Herbidella groups in the mtLSU phylogeny (Fig. 1) and in the *BEAST species tree (Fig. 3), it is placed within the clade together with Festivella, Hungarica and Psychrophila groups in the concatenated tree (Fig. 2). Its position is unresolved in the beta-tubulin and ITS phylogenies (Fig. 1). It is the oldest recognized group, separated some 14–23 Mya (Fig. 3).

5.3.7 Key to the groups

1a. Arctic-alpine or boreal-montane………………………… ……………………………………….….. **Psychrophila group**

1b. More thermophilous; absent from boreal and arctic zones; up to sub-alpine belt in temperate zone……….2

2a. Apothecia of reduced size, usually <0.7 mm diam., without or with negligible amounts of chlorinated anthraquinones (not recognized by the spot test with C reagent); pycnidia with Cinereorufa-green and without anthraquinones; without vegetative diaspores; epiphytic, often on twigs ………………………………………………….. **Hungarica group**

2b. Apothecia mostly not reduced in size, mostly 0.5–1.2 mm diam., with chlorinated anthraquinones; pycnidia with anthraquinones (except the Festivella group); vegetative diaspores present or absent; epilithic or epiphytic (rarely on twigs) ……………………………………………………......3

3a. Melanisation by Cinereorufa-green reduced (often in prothallus only) or absent; thallus less than 150 µm thick, grey or occasionally yellow with anthraquinones; vegetative diaspores present or absent; pycnidia red; epiphytic, mostly on the bark of trunks (rarely on twigs)……………………………………………………….. 4

3b. Parts of thallus (sometimes also parts of apothecia) melanized by Cinereorufa-green; thallus more than 150 µm thick in old areoles, always without anthraquinones, not yellow; vegetative diaspores absent; pycnidia red or dark grey; mostly on siliceous rocks (except *B. catalinae*)……………………………………………………..5

4a. Chlorinated anthraquinones often reduced to the outer part of apothecial margin; vegetative diaspores absent; a single recent species, in southern Scandinavia, Spain ……………………………………………….**Relicta group**

4b. Chlorinated anthraquinones in the most surface of apothecial margin; vegetative diaspores present or absent; seven recent species; broadly distributed……………………………………….... **Herbidella group**

5a. With distinct black prothallus/hypothallus; pycnidia usually dark grey, with Cinereorufa-green, rarely red with anthraquinones; hymenium not inspersed; restricted to Mediterranean regions and Macaronesia…………………………………………......**Festivella group**

5b. Black prothallus present, but often inconspicuous; pycnidia always red; hymenium inspersed (except *B. catalinae*); broadly distributed…………………….... **Crenularia group**

5.4 Species and infraspecific taxa

5.4.1 **Blastenia afroalpina** Vondrák, **sp. nov.**

MycoBank: MB 822478; Fig. 8A

Etymology: Known from an alpine habitat in Central Africa.

Type: Uganda. Mt. Elgon, alt. 4100 m, 1.13333° N, 34.51666° E, on twigs of *Erica trimera*, 30 January 1997, *G. & S. Miehe U09-10701* (holotype, GZU).

Type sequences: MF114602 (ITS); MF114864 (mtLSU); MF114997 (beta-tubulin).

Diagnosis: *Morphology:* Thallus crustose, grey (or yellowish in patches), less than 100 µm thick, scabrose; vegetative diaspores absent; apothecia red, 0.4–0.7 mm diam.; ascospore length (12.5–)14.1(–16.0) µm [1.24; 1; 10]; pycnidia red, common in the type specimen. Other related species from the Herbidella group have larger apothecia, often >0.7 mm diam. Species from the Hungarica group have similar size of apothecia, but different anthraquinone chemistry.

Chemistry: Nonchlorinated anthraquinones in apothecial disc, chlorinated anthraquinones in exciple; thallus without anthraquinones; Cinereorufa-green in thallus.

Ecology: Epiphytic, on shrub twigs in subalpine zone in tropics.

Geography: Central Africa. Known only from the type specimen.

Genome size: 21.3 Mb (CV = 11.7); not reliable; see the Methods for age-induced genomic changes.

Phylogeny: According to all analyses (Figs. 1–3), *B. afroalpina* belongs to the Herbidella group, and its closest relationship to *B. herbidella* is supported in the concatenated tree (Fig. 2), but not supported in the *BEAST species tree (Fig. 3). BP&P supported *B. afroalpina* as a delimited species (PP = 0.94).

5.4.2 **Blastenia ammiospila** (Wahlenberg) Arup, Søchting & Frödén

Lecidea ammiospila Wahlenb., in Acharius, Methodus (Supplementum) 13-14. 1803.

Type: Norway. Kuatokeino, [ca. 69.155690° N, 23.766820° E], on wood, 22 April 1802, *G. Wahlenberg* (holotype, UPS, L-097792; isotype, S, L1903!).

Description: *Morphology:* Thallus crustose, grey, less than 100 µm thick; vegetative diaspores absent; apothecia red, 0.7–1.0 mm diam.; acospore length (12.5–) 14.5–15.0–15.5(–18.0) µm [1.18; 4; 35]; pycnidia rarely present, red, with anthraquinones.

Chemistry: Chlorinated anthraquinones in whole apothecia; nonchlorinated chemosyndrome with predominated parietin absent or present (see Table S3); thallus without anthraquinones; Cinereorufa-green only in traces.

Ecology: Epiphytic, on bryophytes, plant debris or wood, alpine shrubs (*Juniperus*, *Rhododendron*, *Salix*, etc.), rarely on tree bark (e.g., *Populus tremula*); see Table 4 for details. Mostly arctic-alpine, but also recorded in boreal forests. The species has been exceptionally recorded on (seemingly) inorganic substrates (e.g., Vondrák 13638; Hrubý Jeseník Mts.), but in these cases, inconspicuous deposits of organic material were present below the thalli and other *B. ammiospila* thalli were present nearby on organic substrates.

Geography: Circumpolar in arctic to temperate zones of the Northern Hemisphere and also known to be widespread in Antarctica (Søchting et al., 2004). Only ITS sequences are available for four Antarctic specimens and they are in 99% identical with European sequences, suggesting recent long-distance dispersal to Antarctica.

Genome size: 27.1 Mb (CV = 9.8), measured in sample Urbanavichus PAZ150801.

Phylogeny: According to all analyses (Figs. 1–3), *B. ammiospila* belongs to the Psychrophila group and is related to *B. scabrosa* (Figs. 2, 3). BP&P supported *B. ammiospila* as a delimited species.

5.4.3 **Blastenia anatolica** Halıcı, Arup & Vondrák, **sp. nov.**

MycoBank: MB 822479; Fig. 8B

Etymology: Named after the region where it was first recorded, Anatolia in Turkey.

Type: Turkey. Kayseri, Talas, Ali Dağı, alt. 1680 m, 38.6582° N, 35.5546° E, on bark of *Pinus nigra* subsp. *pallasiana*, 2008, *Gökhan Halıcı CL82* (holotype, PRA).

Type sequences: MF114794 (ITS); MF114983 (mtLSU); MF115122 (beta-tubulin).

Diagnosis: *Morphology:* Thallus crustose, grey or yellow, less than 100 µm thick; vegetative diaspores present, granular isidia, (50–)80–108–130(–220) µm diam. [37; 7; 65]; isidia, when dense, give the thallus a thicker appearance (up to 300 µm); apothecia red, 0.6–1.0 mm diam.; ascospore length (11.0–)11.8–12.8–13.8(–17.0) µm [1.40; 5; 69]; pycnidia red with anthraquinones. We consider the new species morphologically indistinguishable from *B. monticola*. *Blastenia herbidella* is also similar, but has smaller isidia, often at least partly coralloid.

Chemistry: Nonchlorinated anthraquinones in apothecial disc, chlorinated anthraquinones in exciple; thallus with or without anthraquinones (yellow thalli observed in Caucasian localities); traces of Cinereorufa-green in thallus.

Ecology: Epiphytic, on bark or wood in upper montane forests (on *Abies nordmanniana*, *Pinus nigra*) in altitudinal range 1500–2000 m.

Geography: Known from Caucasus Mts. (Russia, Abkhasia) and from several Turkish mountains in provinces Bursa, Kayseri and Konya.

Genome size: 31.8 Mb (CV = 9.7), measured in sample Frolov 675.

Phylogeny: According to all analyses (Figs. 1–3), *B. anatolica* belongs to the Psychrophila group. It is closely related to *B. furfuracea* in the ITS tree (Fig. 1) and in the concatenated tree (Fig. 2), but *BEAST did not resolved its closer relationships within the group (Fig. 3). BP&P supported *B. anatolica* as delimited species (PP = 1).

Note: Whereas *B. anatolica* has a grey thallus in all Turkish localities, in the Caucasus Mts. it also has a variant with a yellow thallus with anthraquinones.

5.4.4 **Blastenia catalinae** (H. Magnusson) E.D. Rudolph, in Kondratyuk, Kim, Yu, Jeong, Jang, Kondratiuk, Zarei-Darki & Hur

Caloplaca catalinae H. Magnusson, Botaniska Notiser 1944: 71–72. 1944.

Blastenia catalinae (H. Magnusson) E.D. Rudolph, Revisionary studies in the lichen family Blasteniaceae in North America north of Mexico. - Diss. Abst. 15(8): 100–101. 1955; Nomen invalidum (not effectively published; in Ph.D. thesis; Article 30.8 of ICBN).

Type: USA. California, Santa Catalina Island, Avalon, on bark of *Quercus*, 14 March 1904, coll. C.F. Baker, C.F. Baker: Pacific slope lichens 4028 (lectotype, S, L2615; lectotype selected here as a part of the specimen, the lichen with chlorinated anthraquinones in both the margin and the disc, MBT386428).

Description: *Morphology:* Thallus crustose, grey, less than 100 µm thick; vegetative diaspores absent; apothecia orange to dark red, 0.4–0.9 mm diam. (smaller than in the related *B. crenularia* and *B. purpurea*); ascospore length (13.0–) 15.1(–18.0) µm [1.91; 1; 10]; pycnidia red, with anthraquinones.

Chemistry: Nonchlorinated anthraquinones in the apothecial disc, chlorinated anthraquinones in exciple (Frolov 1237, 1238, Klepsand JK14-1130A) or chlorinated anthraquinones in both disc and exciple (type specimen, Vondrák 7488) or chlorinated anthraquinones completely reduced (Klepsand JK14-1130B). Thallus without anthraquinones; traces of Cinereorufa-green in the thallus.

Ecology: Epiphytic, known from shrub and deciduous tree twigs in maritime habitats or inland in altitudes up to 600 m.

Geography: Western North America; DNA data from California only.

Genome size: 28.9 Mb (CV = 10.2), measured in sample Frolov 1238.

Phylogeny: According to the analysis of the concatenated dataset, *B. catalinae* belongs to the Crenularia group and is related to *B. crenularia* and *B. purpurea* (Fig. 1); this relationship is also supported in Beta-tubulin and mtLSU phylogenies, but it is not resolved by ITS (Fig. 2). BP&P supported *B. catalinae* as a delimited species (PP = 1).

Note: The three different chemotypes may represent three closely related species within *B. catalinae*. This hypothesis is supported by the ITS tree where the specimens without chlorinated anthraquinones form a group distinct from the two genotypes representing the other two chemotypes. Wider sampling and additional mtLSU and beta-tubulin sequence data are necessary to test the three-species hypothesis.

Nomenclature: In the original description, Magnusson (1944a) designated the type as the Baker's exsiccate "Pacific slope lichens 4028" placed in the Lund herbarium (LD). This was the only reference he gave, not citing any other herbaria. It is documented that he had material on loan from Lund in 1942 at the time of preparing the publication on *Caloplaca* in North America (Magnusson, 1944a). No material of the Baker's exsiccate is currently available in Lund, but a fragment of the exsiccate, possibly taken from Lund, is now deposited in Magnusson's own herbarium in Uppsala (UPS). Another specimen of Baker's exsiccate 4028, deposited in Stockholm (S), is marked by Magnusson "*Calopl. catalinae* H. Magn. n. sp. Typus! Det. A. H. Magnusson 1942". It is unclear whether the specimen in Stockholm is the original type and Magnusson incorrectly stated that it was in Lund or whether the Lund material has ended up in S after passing through the herbarium of E. P. Vrang. We consider both specimens to be part of the original material (syntypes) and we typify the name with the material in S since it is richer than the material in Uppsala. This material contains two of the chemotypes described above and we select the one that contains chlorinated anthraquinones in both the margin and the disc as lectotype.

5.4.5 **Blastenia caucasica** I.V.Frolov & Vondrák, **sp. nov.**

MycoBank: MB 822480; Figs. 8C, 8D

Etymology: Named after the Caucasus Mts.

Type: Abkhazia. Caucasus Mts, Ritsinski National Park, pass Pyv about 3 km SE of hospital Auadkhara, alt. 1990 m, 43.48333° N, 40.68333° E, on the vertical face of base-rich siliceous outcrops just above timberline, 2 July 2014, *Ivan Frolov 763b* (holotype, PRA). The holotype specimen is only a part of the specimen 763 that includes three phenotypes (see Fig. 8D): with C- pale apothecia and dark thallus (Frolov 763a), with C- dark apothecia and pale thallus (Frolov 763b) and with dark apothecia and with C+ purple apothecial discs (Frolov 763c).

Type sequences: MF114691 (ITS); MF114927 (mtLSU); MF115055 (beta-tubulin).

Diagnosis: *Morphology:* Thallus crustose, grey, usually up to 150 μm thick, but thicker in old thalli with convex areoles; vegetative diaspores usually absent, but rough isidia present in some specimens (e.g., Frolov 676); apothecia red, 0.8–1.2 mm diam.; ascospore length (12.5–)14.6(–16.0) μm [1.25; 1; 10]; pycnidia red with anthraquinones. Specimens without vegetative diaspores are morphologically indistinguishable from *B. psychrophila*, specimens with rough isidia are indistinguishable from *B. scabrosa*.

Chemistry: Nonchlorinated anthraquinones in the apothecial disc, chlorinated anthraquinones in exciple; in specimen Frolov 763, we observed also a thallus with chlorinated anthraquinones in the whole apothecial surface; thallus without anthraquinones, with Cinereorufa-green.

Ecology: Epilithic, on vertical and overhanging base-rich siliceous rocks in the subalpine/alpine zone, at altitudes around 2000 m.

Geography: Known only from six localities in western Caucasus Mts. (Abkhazia).

Genome size: 29.3 Mb (CV = 5.5), measured in specimen Frolov 670.

Phylogeny: According to all analyses (Figs. 1–3), *B. caucasica* belongs to the Psychrophila group, but its relationships within the group are unresolved. BP&P supported *B. caucasica* as a delimited species (PP = 1).

5.4.6 **Blastenia circumpolaris** Søchting, Frödén & Arup

Type: Australia. Victoria, Mt. Macedon, on tree bark, April 1886, *F.R.M. Wilson 716* (holotype, NSW 732248-1).

Caloplaca wilsonii S.Y. Kondr. & Kärnefelt in Kondratyuk, Kärnefelt, Elix & Thell, Bibliotheca Lichenologica 100: 271. 2009.

Description: *Morphology:* Thallus crustose, grey or yellow, less than 100 μm thick; vegetative diaspores present, soredia, ca. 10–35 μm diam., soralia ± concave, yellow–brownish orange; apothecia orange to rusty red, disc partly green or blackened (see fig. 27 in Kondratyuk et al., 2009a), 0.3–0.7 mm diam.; ascospore length not examined, but (7–)10–13(–16) μm long according to Kondratyuk et al. (2009a); pycnidia not seen.

Chemistry: Nonchlorinated anthraquinones in apothecial disc and exciple, chlorinated anthraquinones in exciple (7-chloroemodine reported by Kondratyuk et al., 2009a: 272), but in a low amount (hypochlorite reaction indistinct); thallus without or with traces of anthraquinones, but anthraquinones present in the yellow soralia; Cinereorufa-green distinct in prothallus and often in apothecial discs.

Ecology: Epiphytic, on bark of tree trunks (e.g., *Acacia*, *Eucalyptus*, *Nothofagus*) at low altitudes, up to 700 m. Once recorded epilithic, on stone in forest floor (Søgaard 69, Chile).

Geography: Known from Australia, Tasmania (Kondratyuk et al., 2009a) and Chile (Arup et al., 2013).

Genome size: Not measured (scarcity of material).

Phylogeny: According to all analyses (Figs. 1–3), *B. circumpolaris* belongs to the Herbidella group. It is related to *B. afroalpina*, *B. ferruginea*, *B. herbidella* and *B. remota* in the concatenated tree (Fig. 2), but its position is unresolved within the group in the *BEAST species tree (Fig. 3). BP&P supported *B. circumpolaris* as a delimited species (PP = 0.94).

5.4.7 **Blastenia coralliza** (Arup & Åkelius) Arup, Søchting & Frödén

Caloplaca coralliza Arup & Åkelius, Lichenologist 41: 471. 2009.

Type: Sweden. Skåne: Kågeröd par., Knutstorp, ca. 200 m N of the castle. On old *Quercus* in wooded meadow, alt. ca. 90 m, *Ulf Arup 06075* (holotype, LD; isotypes, C, MIN).

Description: *Morphology:* Thallus crustose, grey or beige or yellow to orange, <100 μm thick; vegetative diaspores present, coralloid blastidia, 50–120 μm wide and up to 800 μm tall, exceptionally vegetative diaspores absent (Malíček 5561, Andalusia); blastidia, when dense, give the thallus a thicker appearance (up to 900 μm; Arup & Åkelius

2009); apothecia absent or rare (Scandinavia, Canary Islands) or frequent, orange to pale red, 0.7–1.1 mm diam.; ascospore length (9.0–)10.7–12.8–14.8(–16.0) µm [1.97; 3; 29]; pycnidia red with anthraquinones, but rarely present. Further data in Arup & Åkelius (2009).

Chemistry: Nonchlorinated anthraquinones in the apothecial disc, chlorinated anthraquinones in exciple; thallus without anthraquinones or with anthraquinones; Cinereorufa-green only in traces (in prothallus and tips of blastidia).

Ecology: Epiphytic, on bark or wood of numerous tree species (seeTable S1), in low altitudes in Scandinavia (up to 100 m), but with a high altitudinal range in the Mediterranean basin and Macaronesia (reaching 1600 m; Fig. 11). According to our data, *B. coralliza* is more common in the Mediterranean region and more thermophilous than the similar *B. herbidella* (Fig. 11).

Geography: Known in the Mediterranean basin from Albania, Croatia, France, Greece, Italy, Slovenia, Spain, Syria, Tunisia and Turkey. Also present in Canary Islands (La Palma). In the north, reaches oceanic western Europe (France, Germany) and southern Scandinavia (See fig 5 in Arup & Åkelius, 2009). It is absent from most of Central Europe and in more eastern regions.

Genome size: 26.8 Mb (CV = 11.1), measured in sample Vondrák 10876.

Phylogeny: According to all analyses (Figs. 1–3), *B. coralliza* belongs to the Herbidella group, but its position differs slightly among trees. BP&P supported *B. coralliza* as a delimited species (PP = 1).

5.4.8 **Blastenia crenularia** (Withering) Arup, Søchting & Frödén

Lichen crenularius Withering, Bot. arr. veg. Gr. Brit. (London) 2: 709. 1776.

Type: United Kingdom. Isle of Wight, May 1794, *Withering* (lectotype, BM; selected by Laundon 1984, p. 231).

Description: *Morphology:* Thallus crustose, grey; young thalli with flat areoles up to 150 µm thick, but old thalli with uneven upper surface of areoles may be thicker (up to 500 µm); thallus may also be indistinct, especially when growing on sandstone; vegetative diaspores absent; apothecia red, 0.7–1.1 mm diam.; hymenium frequently inspersed (unlike in other *Blastenia* species); ascospore length (11.5–)14.0–14.8–15.8(–17.5) µm [1.27; 7; 63]; pycnidia red with anthraquinones.

Chemistry: Nonchlorinated anthraquinones in the apothecial disc, chlorinated anthraquinones in exciple; thallus without anthraquinones; Cinereorufa-green usually present in thallus and sometimes in apothecia (blackened parts).

Ecology: Epilithic, on various types of coastal or inland siliceous rocks (occasionally on dust-impregnated wood). On seashores, it usually avoids supralittoral zone and occurs in places sheltered from salt spray. It is restricted to regions with a mild climate; for instance in Central Europe, it occurs only on xerothermic volcanic rocks, mostly in river valleys at low altitudes. It reaches higher altitudes only in Iran, Mediterranean mountains and in Macaronesia (up to 2000 m). In Macaronesia, it grows at a higher altitude than the similar *B. festivella*. In Western Europe and in the Mediterranean basin, it descends to seashore rocks, so it has a broad altitudinal range (about 0–1900 m). Its upper altitudinal limit decreases to some 200 m in more northern territories, e.g., in Great Britain and in Scandinavia (Fig. 10).

Geography: Widely distributed in the whole Mediterranean basin, from Caspian Sea coasts to Spain. In oceanic northern Europe, it reaches Iceland (65.83°N) and the coast of Northern Scandinavia (70.63°N), but in the more continental parts of Europe, it only reaches Germany, the Czech Republic and Slovakia. Its easternmost limits are Crimea, SW coasts of the Caspian See and NW Iran. It also occurs in Madeira and the Canary Islands.

Genome size: Ranges between 28.6 and 35.7 Mb (CV = 6.4–9.8; ten samples measured).

Phylogeny: According to all analyses, *Blastenia crenularia* is a part of the Crenularia group and is closely related to *B. purpurea* (Figs. 1–3). BP&P supported *B. crenularia* as a delimited species (PP = 1).

Note: Wetmore (1996) reported *B. crenularia* from the Caribbean islands. His description of the Caribbean population fits *Blastenia* well, but we have not seen his material. If it belongs to *Blastenia*, it is probably a distinct species, more thermophilous than any known epilithic *Blastenia*.

5.4.9 **Blastenia ferruginea** (Hudson) A. Massal.

Lichen ferrugineus Hudson, Fl. Angl.: 444. 1762.

Type: France. Alpes-de-Haute-Provence, Gorges Du Verdon, SW-S from La Palud-sur-Verdon, alt. 850 m, 43.76294° N, 6.31700° E, 9 May 2015, *Ivan Frolov 966* (conserved type, PRA; isotypes, BM, GZU, herb. Frolov). Conserved type proposed by Arcadia & Vondrák (2017). (The type was eventually placed in PRM, contrary to the intention stated in Arcadia & Vondrák, 2017.)

Description: *Morphology:* Thallus crustose, white to grey, usually less than 100 µm thick; vegetative diaspores absent; apothecia red; 0.7–1.0 mm diam.; ascospore length (11.0–)13.2–13.9–14.5(–17.0) µm [1.5; 4; 40]; pycnidia red with anthraquinones.

Chemistry: Nonchlorinated anthraquinones in the apothecial disc; chlorinated anthraquinones in exciple; thallus without or rarely with traces of anthraquinones; Cinereorufa-green in prothallus.

Ecology: Epiphytic, on the bark of tree trunks; 43 records on various deciduous trees (e.g., *Quercus* spp., *Acer* spp., more in Table S1), but only four records on conifers. Only two records on twigs and two on Mediterranean shrubs; not recorded on wood. It occurs at altitudes 10-1200 m in the Mediterranean, but only lowland records are known outside the Mediterranean region (London and New Forest in Great Britain).

Geography: Widely distributed in the northern half of the Mediterranean region. Known from Crimea, Croatia, Cyprus, France, Greece, Italy, Slovenia, Spain and Turkey. It is probably very sparse in non-Mediterranean Europe, known only from two localities in southern Great Britain. Historical specimens from Germany, called "*Caloplaca ferruginea*" (e.g., Lübeck, Erichsen 6.6.1903; Schwarzwald, Poelt 12437), probably belong to *B. ferruginea*, but are not confirmed by DNA sequences.

Genome size: 31.7 Mb (CV = 8.0); measured in specimen Ivan Frolov 966 (Verdon, France).

Phylogeny: Blastenia ferruginea belongs to the Herbidella group (Figs. 1–3). It is related to *B. afroalpina*, *B. circumpolaris*, *B. herbidella* and *B. remota* in the concatenated tree (Fig. 2), but its position is unresolved within the group in the *BEAST species tree (Fig. 3). BP&P supported *B. ferruginea* as a delimited species (PP = 1).

Nomenclature: Historically, the name has been applied to what we here recognize as three species (*Blastenia ferruginea*, *B. lauri* and *B. relicta*) that are hardly distinguishable morphologically. They differ in geographical range, and only one of them occurs in southern England, the type locality for *B. ferruginea*. All sequences provided by Arup et al. (2013) under the name *B. ferruginea*, KC179416 (ITS), KC179163 (nrLSU), KC179493 (mtSSU), belong to the newly described *B. relicta*.

5.4.10 **Blastenia festivella** (Nylander) Vondrák, **comb. nov.**
MycoBank: MB 822481

Lecanora ferruginea var. *festivella* Nylander, Flora, Regensburg 56: 197. 1873.

Type: France. Pyrenees-Orientales, Collioure, Port Vendres [on maritime schist rocks], 4 July 1872, *William Nylander* (lectotype, H-NYL 30260; isolectotype, H-NYL 30259; lectotype selected here, MBT386430).

Blastenia subochracea sensu Arup et al. (2013), not *Caloplaca subochracea* (Wedd.) Werner (see nomenclature note below).

?*Caloplaca limitosa* (Nyl.) H. Olivier (see nomenclature note below); Basionym: *Lecanora limitosa* Nyl. in Flora 63: 387. 1880; Type: Porto in Portugal, ad saxa argilaceo-schistosa [on schist rock], *Newton* (not located).

Description: *Morphology:* Thallus crustose, grey; young thalli up to 150 µm thick, but old thalli with convex to bullate areoles may be thicker (up to 800 µm); black prothallus usually distinct, surrounding thallus margin; vegetative diaspores absent; apothecia red, 0.7–1.1 mm diam., margin sometimes blackened; ascospore length (11.5–) 11.0–11.7–12.7(–17.5) µm [1.34; 9; 89]; pycnidia dark grey with Cinereorufa-green or rarely red with anthraquinones. From *B. crenularia*, it differs by more distinct black prothallus line surrounding thalli, not inspersed hymenium and shorter ascospores, but some specimens of *B. crenularia* are hardly distinguishable.

Chemistry: Nonchlorinated anthraquinones in apothecial disc, chlorinated anthraquinones in exciple (chlorinated anthraquinones in the disc and exciple in similar *B. purpurea*); thallus without anthraquinones; Cinereorufa-green usually present in thallus and sometimes in apothecia (blackened parts).

Ecology: On maritime siliceous rocks. In Portugal and in Macaronesia, also on inland siliceous rocks at altitudes to 1250 m (Fig. 10). Once found on dust impregnated bark of Euphorbiaceae shrub in Madeira. A single truly epiphytic population was recorded in Spanish Andalusia close to Tarifa (36.085533° N, 5.716849° W) on the bark of *Eucalyptus*, *Quercus ilex*, *Q. suber* and *Olea*. In our opinion, the epiphytic population represents a young taxon already delimited from epilithic *B. festivella*, however, it is not separated by the GS and by beta-tubulin and ITS sequences (mtLSU not available) from the saxicolous *B. festivella* (see red dots in Fig. 1).

Geography: Very common in Macaronesia and in the western Mediterranean. Rarely recorded also from the eastern Mediterranean (Greece and Turkey).

Genome size: Ranges between 30.1 and 34.5 Mb (CV = 6.4–8.6; seven specimens measured). *Phylogeny: Blastenia festivella* does not belong to any of the large groups and forms a group of its own (Figs. 1–3). Its position in *Blastenia* is not clear; either it is sister to the Psychrophila group (Fig. 3), or to both Psychrophila and Hungarica groups (Fig. 2). BP&P supported *B. festivella* as a delimited species (PP = 1).

Nomenclature: We adopted the name *Caloplaca festivella* for this taxon because its syntypes reflect our concept of the species: dark prothallus delimiting the thallus, ascospores 10–14 × 5–7 µm, dark grey pycnidia, darkening of apothecial margin by Cinereorufa-green, etc. The syntypes have small (up to 0.7 mm diam.) and partly blackened apothecia which was a reason for describing them as a separate taxon from *L. ferruginea* (at that time in a wide sense). However, the small size of apothecia is caused partly by their youth and partly by poor development. Both syntypes (H-NYL 30259 called *Lecanora festivella*, and H-NYL 30260 called *L. ferruginea * festivella*) represent the same species collected by W. Nylander from schist (very probably maritime rock) in the same place and at the same date [Port Vendres, 4 July 1872]. We designated the latter as lectotype here because its name reflects exactly the name in the protologue (Nylander, 1873) and it consists of richer material.

For this taxon, Arup et al. (2013) made the new combination *Blastenia subochracea* (Wedd.) Arup, Søchting & Frödén from *Lecanora aurantiaca* var. *subochracea* Wedd. (Weddell, 1873: 363; type not located). The sequenced material was collected on basalt in the Azores close to the sea whereas the type of *Lecanora aurantiaca* var. *subochracea* was collected on shaded walls of limestone at Parc de Bollac, Poitiers, France. It must belong to a different species that is not *Blastenia* (*Blastenia* avoids limestone). In addition, the type description of *Lecanora aurantiaca* var. *subochracea* indicates that the thallus is pale yellow and K+ purple, unlike *B. festivella*.

Another name, *Caloplaca limitosa* (Nyl.) H. Olivier, has been currently used for this species by some Mediterranean authors (e.g., Nimis, 2016). Although we have not seen its type (not located in H-NYL), it may be conspecific with *Blastenia festivella*. Nylander (1880: 387–388), in his protologue, mentioned an important character, the black prothallus line delimiting individual thalli. This and all other characters in the protologue fit *Blastenia*. Nylander indicated one locality, Porto (Portugal), on schist rock. That is consistent with the ecology and distribution of *Blastenia festivella*, which is common in Portugal and can grow on non-calcareous schist. If the synonymy could be confirmed, the correct name for this species would be *Blastenia limitosa*.

5.4.11 **Blastenia furfuracea** (H. Magnusson) Arup, Søchting & Frödén

Caloplaca furfuracea H. Magnusson, Göteborgs Kungl. Vetensk. Samhälles Handl., Ser. B, Math. Naturvensk. Skr. 3: 33. 1944.

Type: Sweden. Jämtland, Undersåker Hålland, *G. O. Malme, Lich. Suec. Exs. 763* (lectotype, GB, selected by Wetmore 2004 (as holotypus); isotypes, H, LD, S).

Description: *Morphology:* Thallus crustose, grey to almost black or rarely yellow, <100 µm thick; vegetative diaspores present, granular blastidia, 40–70 µm diam.; blastidia, when dense, give the thallus a thicker appearance (up to 340 µm; Arup & Åkelius, 2009); apothecia pale to dark red, 0.7–1.2 mm diam.; ascospore length (11.0–)12.9–13.0–13.2(–15.0) µm [1.04; 4; 40]; pycnidia red, but sparse or absent. Further data in Arup & Åkelius (2009).

Chemistry: Nonchlorinated anthraquinones in apothecial disc, chlorinated anthraquinones in exciple; thallus without anthraquinones or rarely yellow, with anthraquinones (Davydov 10713, Altai Mts.); Cinereorufa-green usually present in the thallus, especially in tips of blastidia.

Ecology: Epiphytic on tree bark or weathered wood of snags and stumps. Usually associated with boreal tree species (e.g., *Betula*, *Chosenia*, *Pinus*, *Pseudotsuga*), but also on *Quercus* in southern Ural Mts. Known from a broad range of altitudes (300–2200 m).

Geography: Circumpolar in the boreal zone of the Northern Hemisphere. Known from Scandinavia, the Alps and North America (Arup & Åkelius, 2009; Wetmore, 2004). We further recorded this species from a broad range of longitude in Eurasia: the Ural Mts. (57.5° E), Altai Mts. (83.0° E & 85.6° E), and from the Kodar ridge in the Zabaikalsky Krai (117.3° E).

Genome size: 27.3 Mb (CV = 9.8); measured in sample Davydov 10713 (Altai Mts.).

Phylogeny: According to all analyses (Figs. 1–3), *B. furfuracea* belongs to the Psychrophila group. It is closely related to *B. anatolica* in the ITS phylogeny, but its position within the group is unresolved in the mtLSU and beta-tubulin trees (Fig. 1). Whereas the concatenated tree supported a sister relationship of *B. anatolica* and B. furfuracea, the *BEAST species tree did not resolve their relationship. BP&P supported *B. furfuracea* as a delimited species (PP = 1).

Note: Arup & Åkelius (2009) characterized *B. furfuracea* by a grey to black thallus without anthraquinones, which may be true for Europe, but in the Altai Mts there is also a variant with a yellow thallus with anthraquinones.

5.4.12 **Blastenia gennargentuae** Vondrák, **sp. nov.**

MycoBank: MB 822482; Fig. 8E

Etymology: Named after the type locality in the area Gennargentu.

Type: Italy. Sardinia: Gennargentu National Park, Fonni, N slope of Mt. Monte Spada, alt. 1450 m, 40.06666° N, 9.28333° E, on the vertical face of a granite outcrop in the montane pasture, 1 May 2012, *Jan Vondrák 9609* (holotype, PRA).

Type sequences: MF114665, MF114686, MF114763 (ITS); MF114923 (mtLSU); MF115051 (beta-tubulin).

Diagnosis: *Morphology:* Thallus crustose, grey; young thalli up to 150 µm thick, but old thalli with convex to bullate areoles may be thicker (up to 800 µm); black prothallus is not restricted to thallus margin, but is usually distinct among areoles and also forms a black layer in medulla (hypothallus); vegetative diaspores absent; apothecia red, 0.7–1.0 mm diam., apothecial margin often blackened; ascospore length (10.0–)12.2–12.9–13.9(–15.0) µm [1.24; 3; 31]; pycnidia dark grey with Cinereorufa-green. Black hypothallus is characteristic for the species but may be absent. Blackening of apothecial margin is typical, but is occasionally observed in other species (e.g., *Blastenia festivella*, *Caloplaca fuscorufa*). Small ascospores and grey (not red) pycnidia are diagnostic against *B. crenularia*, *B. caucasica* and *B. psychrophila*. Strongly melanized specimens of *B. festivella* with grey pycnidia are hardly distinguishable morphologically.

Chemistry: Nonchlorinated anthraquinones in apothecial disc, chlorinated anthraquinones in exciple; thallus without anthraquinones; Cinereorufa-green forms black patches in thallus, apothecia and pycnidia and often expands into medullar tissue, forming black hypothallus.

Ecology: Epilithic species known from siliceous rocks in Mediterranean mountains at altitudes ca. 1400–1800 m.

Geography: Rare in the Mediterranean mountains. Known only from Calabria and Sardinia.

Genome size: 30.6 Mb (CV = 6.9); holotype measured.

Phylogeny: The position of *B. gennargentuae* is ambiguous; it is possibly related to the Psychrophila group (Fig. 3) or to *B. festivella*. Although it may form a group of its own, we formally included it in the Festivella group (see notes on the group above). BP&P supported *B. gennargentuae* as a delimited species (PP = 1).

5.4.13 **Blastenia herbidella** (Hue) Servít subsp. **herbidella**

Lecidea caesiorufa f. *herbidella* Hue, Nouv. Arch. Mus., Series V, 3: 151. 1911.

Type: Hungary. Arva, supra corticem *Abietis pectinatae* in alpe Chocs comit, [Slovakia. Orava: Mt. Choč, on bark of *Abies alba*], 21 August 1880, *Lojka: Lich. Reg. Hung. Exs. 31* (holotype, PC!; isotypes, B, LD, M, S, UPS!).

Description: *Morphology:* Thallus crustose, grey or rarely yellow, usually less than 100 µm thick; vegetative diaspores present, coralloid or granular blastidia/isidia, 60–160 µm wide and up to 600 µm tall; blastidia, when dense, give the thallus a thicker appearance (up to 700 µm; Arup & Åkelius, 2009); apothecia pale to dark red, 0.7–1.1 mm diam.; ascospore length (9.5–)10.8–12.7–15.0(–17.0) µm [2.00; 4; 33]; one specimen from Turkey (Halıcı, CL226) has large ascospores (mean length 15.0 µm) whereas Arup & Åkelius (2009) reported ascospore length in the range 10.5–13.0 µm; pycnidia red, usually frequent. Further data in Arup & Åkelius (2009).

Chemistry: Nonchlorinated anthraquinones in the apothecial disc, chlorinated anthraquinones in exciple; thallus without anthraquinones or rarely yellow with anthraquinones; Cinereorufa-green usually absent or in traces, but often detectable in tips of isidia/blastidia.

Ecology: Epiphytic on tree trunks (134 records) or rarely on twigs (five records) and only once found on wood. Associated with a number of tree species; Arup & Åkelius (2009) reported its occurrence on forty different tree species. In our dataset, deciduous trees predominate over conifers in ratio 106:28. The preferred substrate is *Acer pseudoplatanus*. It occurs at 25–1800 m altitude (Fig. 11), but records from low altitudes (below 500 m) are mostly from Scandinavia. In the Mediterranean basin, it is restricted to altitudes above 1000 m, but it does not occur above the timberline. Arup & Åkelius (2009) reported it in the alpine zone and on *Rhododendron* shrubs, but those reports refer to *Blastenia monticola* (=*B. herbidella* p.p. sensu Arup et al., 2013).

Geography: Restricted to Europe and adjacent Mediterranean regions (fig. 7 in Arup & Åkelius, 2009). It reaches Southern Scandinavia in the north and Eastern Carpathians and Caucasus Mts. in the east. Records from northern Norway by Arup & Åkelius (2009) belong to *B. monticola*. Its occurrence on Canary Islands (Arup & Åkelius, 2009) is possible but is without DNA confirmation. Various reports from other continents are doubtful and without DNA confirmation.

Genome size: 30.2 Mb (CV = 7.9); measured in sample Vondrák 11335 (Slovakia).

Phylogeny: According to all analyses (Figs. 1–3), it belongs to the Herbidella group. In the beta-tubulin tree, it is closely related to *B. coralliza*, but in the mtLSU tree, it forms a supported subgroup together with *B. afroalpina*, *B. circumpolaris*, *B. ferruginea*, and *B. remota*; in the ITS tree, its position is unresolved (Fig. 1). The concatenated tree supports its closest relationship with *B. afroalpina* (Fig. 2), but the *BEAST tree did not resolve its relationships within the Herbidella groups (Fig. 3). See the Results part for its BP&P support.

5.4.14 **Blastenia herbidella** subsp. **acidophila** Urbanavichene & Vondrák, **subsp. nov.**

MycoBank: MB 822483; Fig. 8F

Type: Russia. Chelyabinsk region, Zyuratkul' National Park, at the coast of the lake Zyuratkul, on bark of *Picea obovata*, 26 May 2009, *Irina Urbanavichene s.n. [Vondrák 17838]* (holotype, PRA).

Type sequences: MF114751 (ITS); MF114964 (mtLSU); MF115059 (beta-tubulin).

Etymology: Named after its strong preference for acid bark.

Diagnosis: *Morphology:* Thallus crustose, grey, <100 µm thick; vegetative diaspores present, coralloid or granular blastidia/isidia, 50–160 µm wide; apothecia pale to dark red, 0.5–0.8 mm diam.; ascospore length (12.0–)13.7(–17.0) µm [1.55; 1; 10]; pycnidia red, but not common. Morphologically similar the subsp. *herbidella*, but has slightly smaller apothecia.

Chemistry: Nonchlorinated anthraquinones in apothecial disc, chlorinated anthraquinones in exciple; thallus without anthraquinones, yellow thalli with anthraquinones not observed; Cinereorufa-green sometimes present in the thallus, mostly in tips of blastidia.

Ecology: Epiphytic, on twigs (rarely on trunks) of boreal trees, such as *Betula* and *Picea obovata,* with rather acidic bark.

Geography: Known from three localities in the north-eastern part of South Ural Mts.

Genome size: Measurements not reliable; old material (Table S2).

Phylogeny: In the mtLSU and ITS trees, subsp. *acidophila* is unresolved from subsp. *herbidella*, but in the beta-tubulin tree, it is distinct from subsp. *herbidella* and more closely related to *B. afroalpina* and *B. remota* (Fig. 1, red dots). In two of three specimens sequenced for beta-tubulin, we revealed also a secondary sequence signal (low peaks) belonging to subsp. *herbidella*. While ancestral within-specimen polymorphism in beta-tubulin is present in subsp. *acidophila*, it was not observed in subsp. *herbidella*.

5.4.15 **Blastenia hungarica** (H. Magnusson) Arup, Søchting & Frödén

Caloplaca hungarica H. Magnusson, Göteborgs Kungl. Vetensk. Samhälles Handl., Ser. B, Math. Naturvensk. Skr. no. 1: 228. 1944.

Type: Hungary. Veszprem, about Juhaszhaz near village Szent Ivan, on bark of *Abies*, 1 March 1917, *Fóriss* (holotype, S).

Description: *Morphology:* Thallus crustose, grey, <100 µm thick; vegetative diaspores absent; apothecia orange to pale red, 0.3–0.8 mm diam.; ascospore length (11.5–) 12.8–13.7–14.3(–16.0) µm [1.39; 3; 29]; pycnidia dark grey with Cinereorufa-green, but usually sparse or absent.

Chemistry: Nonchlorinated anthraquinones in apothecia; chlorinated anthraquinones absent; thallus without anthraquinones; Cinereorufa-green usually hardly detectable, but present around pycnidial ostioles and sometimes accumulated in injured apothecia.

Ecology: Epiphytic on tree trunks (28 records) or twigs (53 records); seven specimens are from wood. Associated with a number of deciduous and coniferous tree species (Table S1), but more frequent on deciduous trees (Table 4). Occurring from lowlands to high altitudes (up to 2000 m), but occurrences below 400 m are mostly restricted to Scandinavia. In the Mediterranean basin, it is restricted to altitudes above 800 m, generally above the altitudinal range of *B. xerothermica* (Fig. 9).

Geography: Restricted to Europe and adjacent Mediterranean regions (Turkey and Caucasus). It reaches Southern Scandinavia in the north (65.1° N) and eastern Caucasus Mts. in the east (46.9° E). The westernmost record is from the French foothills of the Alps (6.32° E). It is probably absent from the Iberian Peninsula, because all eleven sequenced specimens from Spain that resembled *B. hungarica* were identified as *B. xerothermica*, even specimens from high altitudes (up to 1900 m). In more eastern Mediterranean regions, *B. hungarica* is mostly restricted to high altitudes, but with a few records in low altitudinal sub-Mediterranean habitats (e.g., Utrish reserve in the western Caucasus). Records from Mediterranean habitats and from Macaronesia published under *B. hungarica* mostly belong either to *B. xerothermica* or *B. palmae*.

Genome size: 28.2 Mb (CV = 8.8); measured in sample Palice 18699 (Austria).

Phylogeny: According to all analyses, it belongs to the Hungarica group and it is closely related to *B. subathallina* (Figs. 1–3). BP&P supported *B. hungarica* as a delimited species (PP = 1).

5.4.16 **Blastenia lauri** Vondrák, **sp. nov.**

MycoBank: MB 822484; Fig. 8G

Etymology: Our first records came from laurel forests of La Palma.

Type: United Kingdom. Scotland, Oban, Balvicar, alt. 40 m, 56.2700° N, 5.6152° W, on twigs of *Ulmus*, 22 August 2014, *Jan Vondrák 12566* (holotype, PRA).

Type sequences: MF114676 (ITS); MF114916 (mtLSU); MF115040 (beta-tubulin).

Diagnosis: *Morphology:* Thallus crustose, grey, <100 µm thick; vegetative diaspores absent; apothecia red, 0.7–1.2 mm diam.; ascospore length (13.5–)14.8–15.8–17.3(–19.0) µm [1.55;

4; 41]; pycnidia red with anthraquinones. *Blastenia ferruginea* and *B. relicta* are very similar, but have slightly smaller ascospores.

Chemistry: Nonchlorinated anthraquinones in the apothecial disc, chlorinated anthraquinones in exciple; Cinereorufa-green only in prothallus.

Ecology: Epiphytic on trunks and twigs of *Alnus*, *Corylus*, *Ilex*, *Salix* and *Ulmus* in the British Isles, and on *Castanea sativa*, *Ficus carica*, *Lauraceae* spp. and *Pinus canariensis* in Macaronesia. On solitary trees or in forests in a humid climate.

Geography: Known from humid regions of British Isles (mainly western Scotland) and Ireland, and from Canary Islands (data from La Palma and Tenerife) and Madeira.

Genome size: 28.7 Mb (CV = 8.2); measured in sample Vondrák 13109 (Madeira).

Phylogeny: According to all analyses (Figs. 1–3), *B. lauri* belongs to the Herbidella group, but its closer relationships are not resolved. BP&P supported *B. lauri* as a delimited species (PP = 1).

5.4.17 **Blastenia monticola** Arup & Vondrák, **sp. nov.**

MycoBank: MB 822485; Fig. 8H

Etymology: The Latin term means "inhabitant of the mountains", and it reflects the montane occurrence of the species.

Type: Russia. Chelyabinsk' region, Mountain ridge "Bolshaya Suka", at main road Chelyabinsk – Ufa, about 8 km SE of town Bakal, alt. 750–800 m, 54.9166° N, 58.9000° E, on bark of *Picea obovata* in wetland spruce forest, 24 June 2011, *Jan Vondrák 11337* (holotype, PRA).

Type sequences: MF114607 (ITS); MF114867 (mtLSU); MF114999 (beta-tubulin).

Diagnosis: *Morphology:* Thallus crustose, grey or rarely yellow, usually up to 100 µm thick; apothecia red, 0.8–1.2 mm diam.; vegetative diaspores present, granular blastidia/isidia, 50–200 µm diam.; isidia, when dense, give the thallus a thicker appearance (up to 300 µm); ascospore length (8.0–) 9.6–11.8–14.7(–17.0) µm [1.96; 7; 72]; pycnidia red. Morphologically indistinguishable from *B. anatolica*. *Blastenia herbidella* is also similar, but has smaller isidia, often at least partly coralloid.

Chemistry: Nonchlorinated anthraquinones in the apothecial disc, chlorinated anthraquinones in exciple; thallus without anthraquinones or rarely with traces of anthraquinones; Cinereorufa-green usually in traces in the thallus, but accumulated in tips of isidia/blastidia.

Ecology: On bark and wood of subalpine/subarctic trees (e.g., *Abies nordmanniana*, *Cedrus libanii*, *Larix decidua*, *Picea obovata* and *Pinus heldreichii*) and on twigs of arctic/alpine shrubs (e.g., *Juniperus sibirica*, *Rhododendron ferrugineum*).

Geography: Most records are from mountains surrounding the Mediterranean basin including the Alps, Apennines, Pyrenees, and mountains in Balkans and Turkey. Known from Albania, Austria, France, Greece, Italy, Macedonia, Montenegro, Serbia, Spain, Switzerland and Turkey. Also recorded in Caucasus (Abkhazia, Russia), Ural Mts, northern Scandinavia (Sweden and Norway), Russian Arctic (Kola Peninsula) and from southern Siberia (Altai Mts.).

Genome size: 29.8 Mb (CV = 8.5); measured in sample Urbanavichus LK01 (Caucasus Mts.).

Phylogeny: According to all analyses (Figs. 1–3), *B. monticola* belongs to the Psychrophila group, but its closer relationship is not resolved in any of the single-locus trees (Fig. 1) or in the concatenated tree (Fig. 2). The *BEAST tree supported its relationship with *B. scabrosa* and *B. ammiospila* (Fig. 3). BP&P supported *B. monticola* as a delimited species (PP = 1).

5.4.18 **Blastenia palmae** Vondrák, **sp. nov.**

MycoBank: MB 822486; Fig. 8I

Etymology: Our first records came from La Palma.

Type: Portugal. Estremadura, Lisbon, Malveira da Serra, Biscaia, coastal granite cliffs SW of village, alt. 50 m, 38.7538° N, 9.4761° W, on twigs of *Rosmarinum*, 9 October 2014, *Jan Vondrák 12572* (holotype, PRA).

Type sequences: MF114674 (ITS); MF114914 (mtLSU); MF115038 (beta-tubulin).

Diagnosis: *Morphology:* Thallus crustose, grey, <100 µm thick; vegetative diaspores absent; apothecia orange to pale red, 0.4–0.6 mm diam.; ascospore length (10.0–) 11.9–12.6–13.6(–15.0) µm [1.35; 3; 30]; pycnidia dark grey with Cinereorufa-green, but usually sparse or absent. Morphologically indistinguishable from *B. hungarica* and *B. xerothermica* (but both species have different ecology and distribution).

Chemistry: Nonchlorinated anthraquinones in apothecia; chlorinated anthraquinones absent; thallus without anthraquinones; Cinereorufa-green usually hardly detectable, but present around pycnidial ostioles and rarely present in injured apothecia.

Ecology: Epiphytic on tree trunks (9 records) or more frequent on tree twigs (17 records) and on shrub twigs (25 records); only once recorded on wood. Associated with a number of deciduous and coniferous tree and shrub species (Table S1). Occurring from lowlands to high altitudes (up to 1450 m) in Macaronesia, but only in coastal areas in Atlantic Spain and Portugal (up to 300 m; Fig. 9).

Geography: Restricted to Macaronesia (Azores, Canary Islands, Madeira) and to coastal areas of the westernmost Europe (SW Spain, S Portugal).

Genome size: 29.9 Mb (CV = 7.1); measured in sample Frolov 1007 (Spain, Andalusia).

Phylogeny: According to all analyses, it belongs to the Hungarica group and it forms a sister group to *B. hungarica* and *B. subathallina* (Figs. 1–3). BP&P supported *B. palmae* as a delimited species (PP = 1).

5.4.19 **Blastenia psychrophila** Halıcı & Vondrák, **sp. nov.**

MycoBank: MB 822487; Fig. 8J

Etymology: The epithet reflects the strong preference of the species for cold environments.

Type: Turkey. Bursa region, Uludağ Mts., near hotel village, alt. 1960 m, 40.1000° N, 29.1275° E, on siliceous rock, 24 May 2012, *Gökhan Halıcı CL355* & *E. Kılıç* (holotype, PRA).

Type sequences: MF114784 (ITS); MF114976 (mtLSU); MF115112 (beta-tubulin).

Diagnosis: *Morphology:* Thallus crustose, grey, but exceptionally with yellow tinge (Fig. 8K), partly exceeding 100 µm thickness; vegetative diaspores usually absent, but rough isidia-like outgrowths rarely present; apothecia red, 0.7–1.1 mm diam.; ascospore length (10.0–)13.6–15.8–19.1 (–25.0) µm [2.14; 7; 70]; pycnidia red.

Chemistry: Nonchlorinated anthraquinones in the apothecial disc, chlorinated anthraquinones in exciple; thallus without anthraquinones; Cinereorufa-green in the thallus.

Ecology: Epilithic, on vertical and overhanging, but also on rain exposed, base-rich siliceous rocks in subalpine/alpine zone. It occurs at altitudes 1500–2500 m in Mediterranean mountains, but at 1300–2000 m in mountains north of the Mediterranean (Fig. 10).

Geography: Occurring in Mediterranean and Balkan Mountains, the Alps, Carpathinas and Sudetes. Known from Bulgaria (Rila Mts.), France (Massif Central), Greece (Mt. Smolikas), Italy (southern Alps, Apennine Mts.), Kosovo and Macedonia (Šar Planina), Serbia (Stara Planina Mts.), Turkey (seven mountain areas) and Ukraine (Carpathians). The northernmost occurrence is in Poland, Krkonoše Mts. (50.8° N), the easternmost in the Kars province of Turkey (42.7° E).

Genome size: 26.9 Mb (CV = 10.5), measured in specimen Vondrák 11852 (Krkonoše Mts.).

Phylogeny: According to all analyses (Figs. 1–3), *B. psychrophila* belongs to the Psychrophila group, but its relationships within the group are unresolved. BP&P supported *B. psychrophila* as a delimited species (PP = 1).

5.4.20 **Blastenia purpurea** Vondrák, **sp. nov.**

MycoBank: MB 822488; Fig. 8K

Etymology: Named after the C+ purple spot reaction in the whole apothecial surface.

Type: Portugal. Madeira, Funchal, Curral das Freiras, at hill Pico do Gato, alt. 1600-1800 m, 32.739043° N, 16.933149° W, on base-rich volcanic rock, 6 March 2015, *Jan Vondrák 13101* (holotype, PRA).

Type sequences: MF114720 (ITS); MF114943 (mtLSU); MF115076 (beta-tubulin).

Diagnosis: *Morphology:* Thallus crustose, grey; young thalli with flat areoles up to 150 µm thick, but old thalli with an uneven upper surface of areoles may be thicker (up to 500 µm); vegetative diaspores absent; apothecia usually dark red, 0.7–1.2 mm diam.; ascospore length (13.0–)15.9(–18.0) µm [1.43; 1; 10]; pycnidia red. *Blastenia crenularia* and *B. festivella* may occur together with *B. purpurea*, but the latter species has a usually deeper red tinge of apothecia and a specific chemistry.

Chemistry: Chlorinated anthraquinones in the apothecial disc and exciple (in closely related *B. crenularia*, chlorinated anthraquineones only in exciple); nonchlorinated anthraquinone chemosyndrome absent; thallus without anthraquinones; Cinereorufa-green in the thallus.

Ecology: Epilithic, on hard volcanic rocks (often with *B. festivella*); known at altitudes 650–1700 m (Fig. 10).

Geography: Known only from the Canary Islands (La Palma, four localities) and Madeira (two localities).

Genome size: 34.2 Mb (CV = 7.8), measured in specimen Vondrák 12629 (La Palma).

Phylogeny: According to all analyses (Figs. 1–3), *B. purpurea* belongs to the Crenularia group and is closely related to *B. crenularia*. BP&P supported *B. purpurea* as a delimited species (PP = 1).

5.4.21 **Blastenia relicta** Arup & Vondrák, **sp. nov.**

MycoBank: MB 822489; Fig. 8L

Type: Sweden. Östergötland, Boxholm, Ö Trehörningen about 10 km NW of Melaxander, alt. 55 m, 58.103393° N, 15.176726° E, on the bark of *Fraxinus excelsior* trunk, 12 May 2012, *Ulrika Nordin FU7663* (holotype, LD).

Type sequences: MF114667 (ITS); MF114911 (mtLSU); MF115034 (beta-tubulin).

Etymology: The epithet reflects the relict character of the species.

Diagnosis: *Morphology:* Thallus crustose, white to grey, <150 µm thick; vegetative diaspores absent; apothecia red, 0.6–1.2 mm diam.; ascospore length (10.5–)12.3–13.6–15.1(–18.0) µm [1.84; 4; 40]; pycnidia rarely present, red, with anthraquinones. Hardly distinguishable from *B. ferruginea* (but the two species are geographically distinct).

Chemistry: Nonchlorinated anthraquinones in the apothecial disc and in excipulum parts adjacent to disc; chlorinated anthraquinones in exciple, but often reduced to outer excipular ring (in the similar *B. ferruginea*, chlorinated anthraquinones in the whole surface of true exciple); thallus without anthraquinones or rarely with traces; Cinereorufa-green only in prothallus.

Ecology: Epiphytic, on bark of tree trunks (*Fraxinus*, *Quercus*, *Populus*, *Salix*, etc.) at low altitudes in Scandinavia (up to 350 m), but up to 1230 m in Spain.

Geography: Known from southern Scandinavia (Norway, Sweden), with the northernmost record confirmed by DNA data at 63.15° N, and from Spain (Asturias, Castilla y León, Castilla La Mancha, Galicia, La Rioja).

Genome size: 30.5 Mb (CV = 7.5); measured in sample Vondrák 17886 (Spain).

Phylogeny: Blastenia relicta forms a group by itself (Figs. 1–3). It forms a sister group to a clade with the Festivella, Hungarica and Psychrophila groups in the concatenated tree (Fig. 2), but its relationship to other groups is unresolved in the *BEAST species tree (Fig. 3). Its position in single-locus trees is incongruent (Fig. 1); whereas in the mtLSU tree, it is sister to the Crenularia and Herbidella groups, in the beta-tubulin tree, it belongs to the clade with the Limitosa, Hungarica and Psychrophila groups. BP&P supported *B. relicta* as a delimited species (PP = 1).

Note: *Blastenia ferruginea* auct., as understood by Arup et al. (2013), refers to *Blastenia relicta* (see also the note below *B. ferruginea*).

5.4.22 **Blastenia remota** Obermayer & Vondrák, **sp. nov.**

MycoBank: MB 822490; Fig. 8M

Etymology: The epithet reflects the geographic isolation of the species from the Mediterranean-Macaronesian hot-spot of *Blastenia* diversity.

Type: China. Sichuan, Daxue Shan, 57 km S of Kangding, Gongga Shan, Hailougou glacier and forest park, alt. 3180-3240, 29.56666° N, 101.96666° E, on *Rhododenron* twigs, 28 July 2000, *Walter Obermayer 9054* (holotype, GZU).

Type sequences: MF114600 (ITS); MF114862 (mtLSU); MF114995 (beta-tubulin).

Diagnosis: *Morphology:* Thallus crustose, grey, <100 µm thick; vegetative diaspores absent; apothecia usually dark red, 0.4–0.9 mm diam.; ascospore length (12.0–)14.0–16.1–17.3(–19.5) μm [2.17; 3; 30]; pycnidia red, but sparse or absent. Morphologically similar to European species of the Herbidella group, but geographically and ecologically distinct.

Chemistry: Nonchlorinated anthraquinones in the apothecial disc, chlorinated anthraquinones in exciple; thallus without anthraquinones; Cinereorufa-green in traces (in the thallus, rarely in apothecia).

Ecology: On bark and twigs of trees and shrubs (*Rhododendron*, *Rosa*, *Salix*) in humid montane forests at an altitude about 3000 m.

Geography: Known from two sites, not far apart, in Sichuan, China. All specimens were collected close to the Hailougou glacier (see Table S1 for details).

Genome size: Measurement failed (old material).

Phylogeny: According to all analyses (Figs. 1–3), *B. remota* belongs to the Herbidella group, but its closer relationships are not resolved. BP&P supported *B. remota* as a delimited species (PP = 0.93).

5.4.23 **Blastenia scabrosa** (Søchting, Lorentsen & Arup) S.Y. Kondratyuk, I. Kärnefelt, J.A. Elix, A. Thell, J. Kim, A.S. Kondr. & J.-S. Hur

Caloplaca scabrosa Søchting, Lorentsen & Arup, Nova Hedwigia 87: 89. 2008.

Type: Norway. Svalbard, Nordenskiöld Land, Reindalen N of Sørhytta, alt. 100 m, 77.994450° N, 15.869419° E, on and under overhanging sandstone, 4 August 1986, *Søchting 5513* (holotype, C!; isotypes, BG, LD, PRA!).

Type sequence: KX022975 (ITS).

Description: *Morphology:* Thallus crustose, grey, thalli usually less than 100 μm thick; vegetative diaspores (tiny blastidia to large knobbly isidia) present, granular or with an irregular shape, 40–130 μm diam.; isidia/blastidia, when dense, give the thallus a thicker appearance (up to 400 μm); apothecia red, 0.8–1.2 mm diam.; ascospore length (12.0–)13.5–14.0–14.3(–17.0) μm [1.05; 3; 30]; pycnidia red, sparse or absent; more information in Søchting et al. (2008); Vondrák et al. (2013); Frolov & Konoreva (2016).

Chemistry: Nonchlorinated anthraquinones in apothecial disc, chlorinated anthraquinones in exciple; thallus without anthraquinones; Cinereorufa-green in thallus, more concentrated in tips of isidia; atranorin in thallus (reported by Søchting et al., 2008 and Vondrák et al., 2013b) was not confirmed by our TLC results.

Ecology: Epilithic, on vertical and overhanging, base-rich siliceous rocks in the arctic and subalpine/alpine zone in European mountains. It occurs at low altitude in the Arctic but is restricted to high altitudes in more southern mountains (1250–2500 m).

Geography: Although described from a single locality in Svalbard (Søchting et al., 2008), it has since been found in Hrubý Jeseník Mountains in the Czech Republic (Vondrák et al., 2013; Vondrák & Malíček, 2015), Tatra Mountains in Poland (Wilk, 2015), Caucasus Mountains in Abkhasia, Murmansk region in Russia, Torne Lappmark in Sweden (Frolov & Konoreva, 2016) and here it is newly reported from Sierra Nevada in Spain.

Genome size: 33.3 Mb (CV = 11.1), measured in specimen Vondrák 13628 (Hrubý Jeseník Mts.).

Phylogeny: According to all analyses (Figs. 1–3), *B. scabrosa* belongs to the Psychrophila group and is closely related to *B. ammiospila* (Figs. 2 and 3). BP&P supported *B. scabrosa* as a delimited species (PP = 1).

5.4.24 **Blastenia subathallina** (H. Magnusson) Arup & Vondrák, **comb. nov.**

MycoBank: MB 822491

Caloplaca subathallina H. Magnusson, Botaniska Notiser 1951 (1): 82. 1951.

Type: Sweden. Gotland, Östergarn, Grogarnsberget, corticolous, August 1871, *Wilhelm Molér* (lectotype, S; lectotype selected here, MBT386429).

Caloplaca depauperata H. Magnusson, K. Vet. O. Vitterh. Samh. Handl., f. 6. ser. B. 3(1): 29–30 (1944b); nomen illegitimum (later homonym).

Description: *Morphology:* Thallus crustose, grey, <100 μm thick; vegetative diaspores absent; apothecia dark red (rarely pale red), 0.3–0.5 mm diam.; ascospore length (12.0–)13.3–13.5–13.8(–15.0) μm [0.83; 3; 31]; pycnidia dark grey with Cinereorufa-green, but usually sparse or absent. Distinct from other species of the Hungarica group with small apothecia by red (not orange) apothecia with chlorinated anthraquinones in the whole surface.

Chemistry: Chlorinated anthraquinones in apothecia; nonchlorinated anthraquinone chemosyndrome with parietin reduced or absent; thallus without anthraquinones; Cinereorufa-green hardly detectable.

Ecology: Usually on twigs of trees (19 records) and shrubs (8 records); more rarely on tree trunks (10 records); not recorded on wood. Associated with a number of deciduous and coniferous tree and shrub species (Table S1). Occurring only at lower altitudes in southern Scandinavia (up to 100 m), in a broad altitudinal range in the Mediterranean basin (0–1500 m) and in the range 1000–1500 m in Madeira and the Canary Islands (Fig. 9). *Geography:* Throughout the Mediterranean region. Known from Bosnia and Herzegovina, France, Greece, Italy, Russia (western Caucasus), Spain and Turkey. In Macaronesia, it is known from La Palma and Madeira. North of the Mediterranean basin, known only in southern Scandinavia (Sweden; up to 58.9° N).

Genome size: 21.6 and 25.9 Mb (CV = 11.8 & 9.0); measured in samples Vondrák 12105 (La Palma) and 13107 (Madeira).

Phylogeny: According to all analyses, it belongs to the Hungarica group and is closely related to *B. hungarica* (Figs. 1–3). BP&P supported *B. subathallina* as a delimited species (PP = 1).

Note: Distinguished from all other species of the Hungarica group by its chemistry. Other species contain nonchlorinated anthraquinone chemosyndrome, but *B. subathallina* only has the chlorinated chemosyndrome (Fig. 6).

5.4.25 **Blastenia xerothermica** Vondrák, Arup & I.V.Frolov, **sp. nov.** subsp. xerothermica

MycoBank: MB 822492; Fig. 8N

Etymology: The epithet reflects the occurrence of the species in dry, warm (i.e., xerothermic) habitats.

Type: France. Alpes-de-Haute-Provence, Gorges du Verdon, SW-S from La Palud-sur-Verdon, alt. ca. 850 m, 43.762933° N, 6.317004° E, on twigs of *Pinus halepensis* in the submediterranean sparse forest on limestone on SE slope, 9 May 2015, *Ivan Frolov 1033* (holotype, PRA; isotype, herb. Frolov).

Type sequences: MF114743 (ITS); MF114955 (mtLSU); MF115091 (beta-tubulin).

Diagnosis: *Morphology:* Thallus crustose, grey, <100 µm thick; vegetative diaspores absent; apothecia orange to pale red, 0.3–0.7 mm diam.; ascospore length (10.0–) 12.7–13.5–15.0(–16.0) µm [1.28; 7; 61]; pycnidia dark grey with Cinereorufa-green, but usually sparse or absent. Morphologically indistinguishable from *B. hungarica* (which prefers upper altitudes and is distributed also outside the Mediterranean) and *B. palmae* (distinct in geographical range).

Chemistry: Nonchlorinated anthraquinones in apothecia; chlorinated anthraquinones strongly reduced or absent; thallus without anthraquinones; Cinereorufa-green usually hardly detectable, but present around pycnidial ostioles and also present in injured apothecia.

Ecology: Epiphytic on trunks of trees (18 records), twigs of trees (31 records) or twigs of shrubs (41 records). Associated with a number of deciduous and coniferous tree and shrub species (Table S1). Occurring mostly at lower altitudes in the Mediterranean regions, but reaching 1550 m in Spain (Fig. 9). The subsp. *macaronesica* has a different ecology (see below).

Geography: Restricted to the Mediterranean basin: known from Albania, southern France, Greece, Italy, Spain and Turkey. The Macaronesian population is separated as a subspecies (see below). Ranges of the subspecies probably do not overlap.

Genome size: 34.1 Mb (CV = 8.9); measured in holotype.

Phylogeny: According to all analyses, *B. xerothermica* belongs to the Hungarica group and it forms a sister group to *B. hungarica*, *B. palmae* and *B. subathallina* (Figs. 2 and 3). Its position in single-loci phylogenies is incongruent: it is a part of the Hungarica group in the beta-tubulin tree, but it is related to the Herbidella and Crenularia groups in the mtLSU tree; its position is unresolved in the ITS tree (Fig. 1). *Blastenia xerothermica* is clearly divided into two clades in the beta-tubulin phylogeny (Fig. 1); they are treated here as geographically separated subspecies. The substantial within-species genotype variability is due to differences between the subspecies (Table 3). Both subspecies in *B. xerothermica* are supported by BP&P as delimited taxa (PP = 0.98).

Note: We did not find any morphological characters separating *B. hungarica*, *B. palmae* and *B. xerothermica*. Nevertheless, *B. xerothermica* occupies a different niche than the other two species. In the Mediterranean basin, it occurs at lower altitudes than *B. hungarica* (Fig. 9), but both species co-occur in some regions (e.g., both species occur in the area of Gorges du Verdon in France). *Blastenia xerothermica* is absent from coastal areas in the south-western part of the Iberian Peninsula where *B. palmae* is common. In Macaronesia, *B. xerothermica* (subsp. *macaronesica*) occurs in "subalpine" habitats above the altitudinal range of *B. palmae* (Fig. 9).

5.4.26 **Blastenia xerothermica** subsp. **macaronesica** Vondrák, **subsp. nov.**

MycoBank: MB 822493; Fig. 8O

Etymology: The epithet reflects the geographical range of the subspecies, parts of Macaronesia.

Type: Portugal. Madeira, Funchal, Curral das Freiras, at hill Pico do Gato, alt. 1750 m, 32.739043° N, 16.933149° W, on dead twigs of *Sarothamnus* shrubs, 6 March 2015, *Jan Vondrák 13103* (holotype, PRA).

Type sequences: MF114722 (ITS); MF114945 (mtLSU); MF115077 (beta-tubulin).

Diagnosis: *Morphology & Chemistry:* As in *B. xerothermica* subsp. *xerothermica* (see above).

Ecology: Epiphytic on trunks, twigs and wood of *Pinus canariensis* (three records) or on alpine shrub twigs (two records) at 1750–2200 m altitudes, above the zone of morphologically identical *B. palmae* (Fig. 9).

Geography: Macaronesia, known from La Palma, Tenerife and Madeira.

Genome size: 32.1 (CV = 6.5); measured in sample Vondrák 12111 (La Palma).

Phylogeny: In the beta-tubulin phylogeny, it forms a clade within the Hungarica group separated from the subsp. *xerothermica*; in ITS, it forms a supported group within the *B. xerothermica* clade, and in mtLSU, it is unresolved from the other subspecies (Fig. 1). It forms a supported lineage inside the subsp. *xerothermica* in the concatenated tree (Fig. 2). BP&P supported this taxon as a delimited species (PP = 0.98), recently separated from the subspecies *xerothermica* (Fig. 3).

Note: Although the taxon is supported as a delimited species by BP&P, we prefer to be conservative and describe it at the rank of subspecies. It is sufficiently resolved only in the beta-tubulin single-gene phylogeny. In the concatenated and other single-gene phylogenies, it is not resolved from *B. xerothermica* subsp. *xerothermica*.

5.5 Key to *Blastenia* species in western Eurasia and Macaronesia

For correct identifications of specimens from regions that are rich in species (especially the Mediterranean), we recommend confirmation by the ITS barcode. It is helpful for distinguishing the following species: (i) *Blastenia hungarica* and *B. xerothermica*; (ii) *B. coralliza* and *B. herbidella*; (iii) *B. ferruginea*, *B. lauri* and *B. relicta*. The key is supplemented by Notes 1–9 (see below).

1a. Apothecia orange to pale red; chlorinated anthraquinones absent or reduced in apothecia (negative spot reaction with diluted hypochlorite solution; C-); apothecia rarely exceeding 0.7 mm diam.; pycnidia dark grey, with Cinereorufa-green; most commonly on the bark of trunk or twigs or on wood………………… 2

1b. Apothecia pale to dark red or rusty red; chlorinated anthraquinones present, at least in outer part of apothecial margin (strong spot reaction with hypochlorite; C+ purple); apothecia of various size; pycnidia red or dark grey; substrates various……………………..5

2a. In Azores, Canary Islands, Madeira or Atlantic coast of Spain and Portugal………………………………………..3

2b. In another region…………………………………………..4

3a. Above 1500 m, in subalpine and upper *Pinus canariensis* belt (known in Tenerife, La Palma and Madeira)………… ………………….... **B. xerothermica** subsp. **macaronesica**

3b. Below 1500 m in Macaronesia; in Spain and Portugal (continent), restricted to coastal areas…………………… ……………………………………………….. **B. palmae**

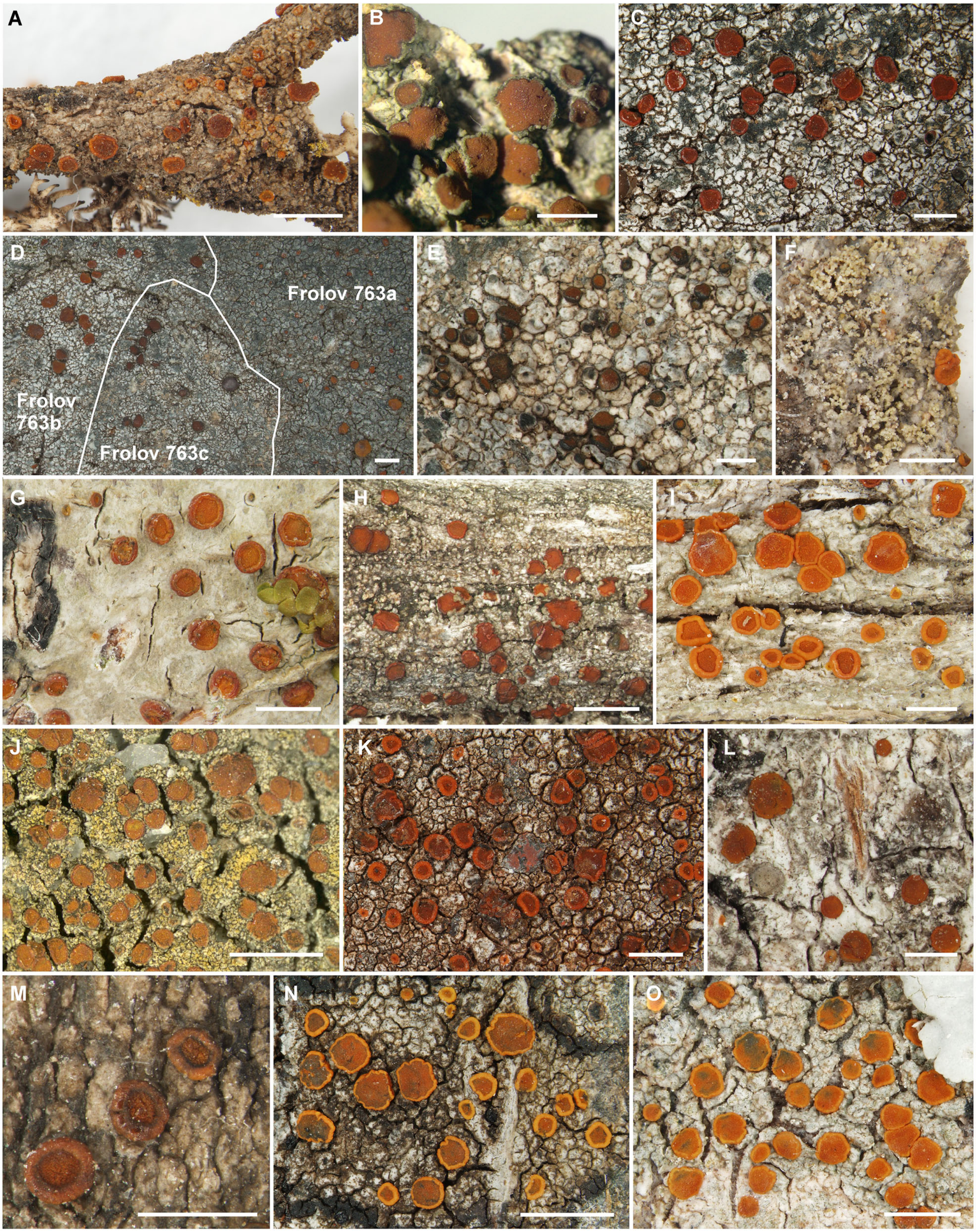


Fig. 8. Holotypes of the new species and subspecies. **A,** *Blastenia afroalpina*. **B,** *B. anatolica*. **C, D,** *B. caucasica*. **E,** *B. gennargentuae*. **F,** *B. herbidella* subsp. *acidophila*. **G,** *B. lauri*. **H,** *B. monticola*. **I,** *B. palmae*. **J,** *B. psychrophila*. **K,** *B. purpurea*. **L,** *B. relicta*. **M,** *B. remota*. **N,** *B. xerothermica* subsp. *xerothermica*. **O,** *B. xerothermica* subsp. *macaronesica*. All scales: 1 mm.

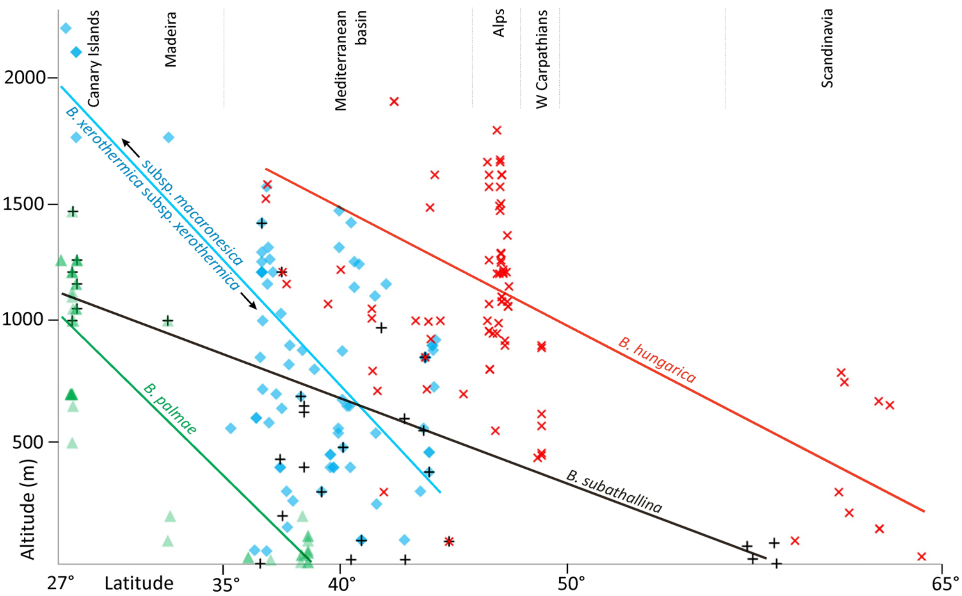


Fig. 9. Latitude/altitude range of species within the Hungarica group: *B. hungarica* (red inclined crosses), *B. palmae* (green triangles), *B. subathallina* (black crosses) and *B. xerothermica* (blue inclined squares). Trend curves interposed by hand.

4a. In Mediterranean lowlands; common in maquis shrublands………………………………………………………… ………………… **B. xerothermica** subsp. **xerothermica**

4b. North of the Mediterranean regions………………… ……………………………………………….**B. hungarica**

4c. In colder Mediterranean areas; mostly in mountains above 1000 …………………………**B. xerothermica** subsp. **xerothermica** or **B. hungarica** (identification requires ITS DNA barcode)

5a. Chlorinated anthraquinones (recognized by C+ purple spot test; see methods for details) in apothecial disc and margin……………………………………………………..6

5b. Chlorinated anthraquinones restricted to apothecial margin……………………………………………………..8

6a. Apothecia small, usually below 0.5 mm diam. (mean of our measurements 0.36 mm); ascospores 12–15 μm long, Cinereorufa-green hardly detected; on twigs (preferred) or trunk bark…………………**B. subathallina** (see note 1)

6b. Apothecia larger, usually above 0.5 mm diam. (means 0.86 and 0.89 mm); ascospores 13–18 μm long; Cinereorufa-green present or not; epiphytic or epilithic……. ……………………………………………………………..7

7a. Mostly arctic-alpine; on organic substrates (bryophytes, plant debris, shrub twigs, wood, rarely bark); atranorin absent from thallus or in traces (not detected by KOH spot reaction); Cinereorufa-green usually not detectable in sections; apothecia flat, rarely slightly convex………. ………………………………**B. ammiospila** (see note 2)

7b. Restricted to Macaronesia; on volcanic rocks; atranorin absent; Cinereorufa-green detectable in sections; apothecia usually flat……………**B. purpurea** (see note 3)

8a. Vegetative diaspores absent……………………………9

8b. Vegetative diaspores present…………………………16

9a. On inorganic substrates; thallus white to dark grey, epilithic; old areoles often convex or with uneven surface and more than 150 μm thick…………………… …………………………………………………………….10

9b. On organic substrates (usually bark of tree trunks); thallus white to pale grey, endophloedal or thinly epiphloedal; areoles flat to slightly convex, usually with even surface (up to 150 μm thick)………………… ……………………………………………...14 (see note 4)

10a. In mountains (mostly in the alpine zone); not in Macaronesia…………………………………………......11

10b. Below alpine zone; some species present in Macaronesia……………………………………………………...13

11a. Pycnidia dark-grey to black, with Cinereorufa-green; apothecial margin often blackened, with Cinereorufa-green; medulla often black accumulating Cinereorufa-green; ascospores small, mostly less than 15 μm long; in dry Mediterranean mountains (known from Calabria and Sardinia)………………...**B. gennargentuae** (see note 5)

11b. Pycnidia red, with anthraquinones; blackened apothecia with Cinereorufa-green rare; medulla, when present, without Cinereorufa-green; ascospore size variable; in humid mountains in western Eurasia…………………..12

12a. In Caucasus Mts…………………………………**B. caucasica**

12b. In other regions…………………………..**B. psychrophila**

13a. Thallus usually distinctly delimited by black prothallus line (forming black lines surrounding thalli); pycnidia black (with Cinereorufa-green) or red (with anthraquinones); hymenium not inspersed; ascospores usually less than 15 μm long; restricted to coastal areas; distributed in the Mediterranean (Spain to Turkey) and Atlantic coast of Europe (Spain and Portugal); common in Macaronesia, mostly at altitudes up to 1000 m……………**B. festivella**

13b. Black prothallus marginal rings usually indistinct; pycnidia red with anthraquinones; hymenium often inspersed; ascospores often more than 15 μm long; in coastal areas and inland; in Macaronesia at altitudes above 1000 m (above the zone of B. festivella)…………...**B. crenularia**

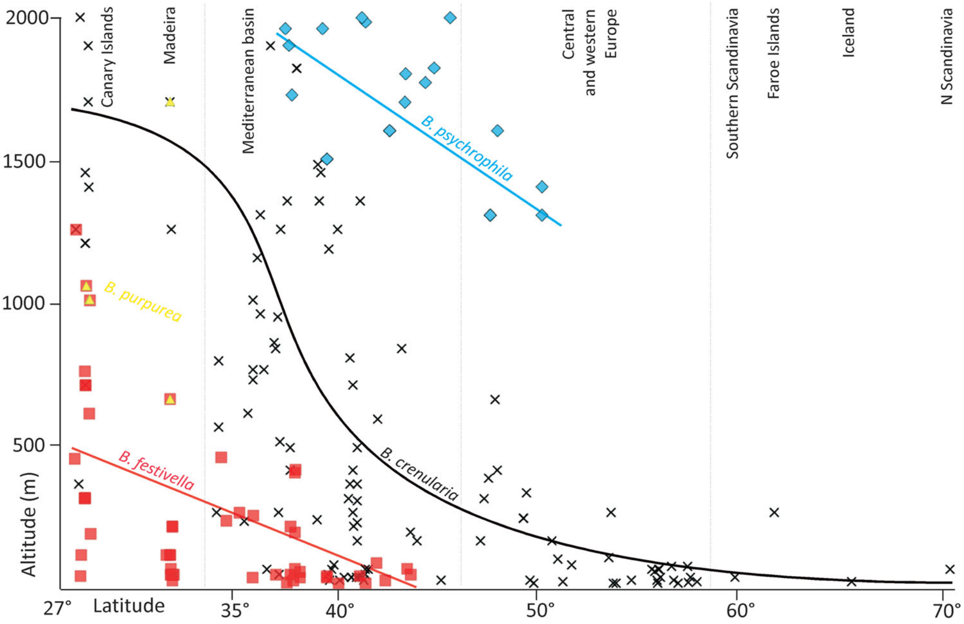


Fig. 10. Latitude/altitude range of phenotypically similar epilithic *Blastenia* species without vegetative diaspores: *B. festivella* (red squares), *B. purpurea* (yellow triangles), *B. crenularia* (black crosses) and *B. psychrophila* (blue inclined squares). Trend curves interposed by hand.

14a. In Macaronesia and in eu-oceanic Europe (known in Scotland, Ireland)………………………………**B. lauri**

14b. In other regions……………………………………………15

15a. In Mediterranean regions; outside the Mediterranean known only in southern Great Britain; chlorinated anthraquinones in the surface of whole apothecial margin………………………………………**B. ferruginea**

15b. Known from Scandinavia and Spain; chlorinated anthraquinones restricted to a thin ring of the outer part of apothecial margin……………………………**B. relicta**

16a. Epilithic, arctic-alpine……………………………………………………………………...**B. scabrosa** (see note 6)

16b. Epiphytic, ecology and distribution various…………………………………………………………..17 (see note 7)

17a. Boreal-montane to arctic-alpine; mostly in acidophilous lichen communities in open coniferous forests or tundra-like habitats; with globose or coralloid blastidia/isidia……………………………………………………....18

17b. Not boreal and not arctic-alpine; in various forest types; in species-rich, slightly nitrophilous and basiphilous lichen communities; typically with coralloid blastidia/isidia……………………………………………....21

18a. With granular or coralloid vegetative diaspores not exceeding 100 µm diam…………………………………19

18b. With granular vegetative diaspores, commonly exceeding 100 µm diam……………………………………...20

19a. With tiny granular blastidia, 30–70 µm diam.; thallus usually grey, but rarely yellow (known from Altai Mts.); on wood (preferred) and bark; boreal……………………………………………………………………**B. furfuracea**

19b. With granular and coralloid blastidia/isidia, ca. 50–100 µm wide; only grey thallus seen; on twigs (preferred) and trunk bark; in Ural Mts……………………………………………………………**B. herbidella** subsp. **acidophila**

20a. In Turkey or in Caucasus Mts…………………………………………….**B. anatolica** or **B. monticola** (see note 8)

20b. In other regions………………………………...**B. monticola**

21a. In Canary Islands…………………………………**B. coralliza**

21b. In Central Europe north of the Alps……………………………………………………………………..**B. herbidella**

21c. In other regions……………………………………………22

22a. Pycnidia red, usually present and sometimes abundant; isidia coralloid or granular, 60–170 µm wide, grey (rarely yellow); rare and restricted to mountain forests in Mediterranean regions……………………………..**B. herbidella** (see note 9)

22b. Pycnidia red, but rarely present (if present, then usually sparse); isidia coralloid or rarely granular, 50–120 µm wide, yellow or grey; common throughout the Mediterranean…………………………...**B. coralliza** (see note 9)

Note 1: *Huneckia pollinii* is very variable and, when growing on twigs, it may also have small apothecia and is hardly distinguishable from *B. subathallina*, but Cinereorufa-green frequently causes blackenings of apothecia in *H. pollinii*. Both species are also distinct in anthraquinones. 7-chloroemodin is the major substance in *B. subathallina*, but chrysophanol, chrysophanal and rhein are major in apothecia of *Huneckia pollinii* (Kondratyuk et al., 2014). Employing TLC on *H. pollinii*, we detected only chrysophanol (yellow spot in the parietin height) and a distinct orange spot in RF 60–70 (solvent C); 7-chloroemodin was not detected. Another similar twig

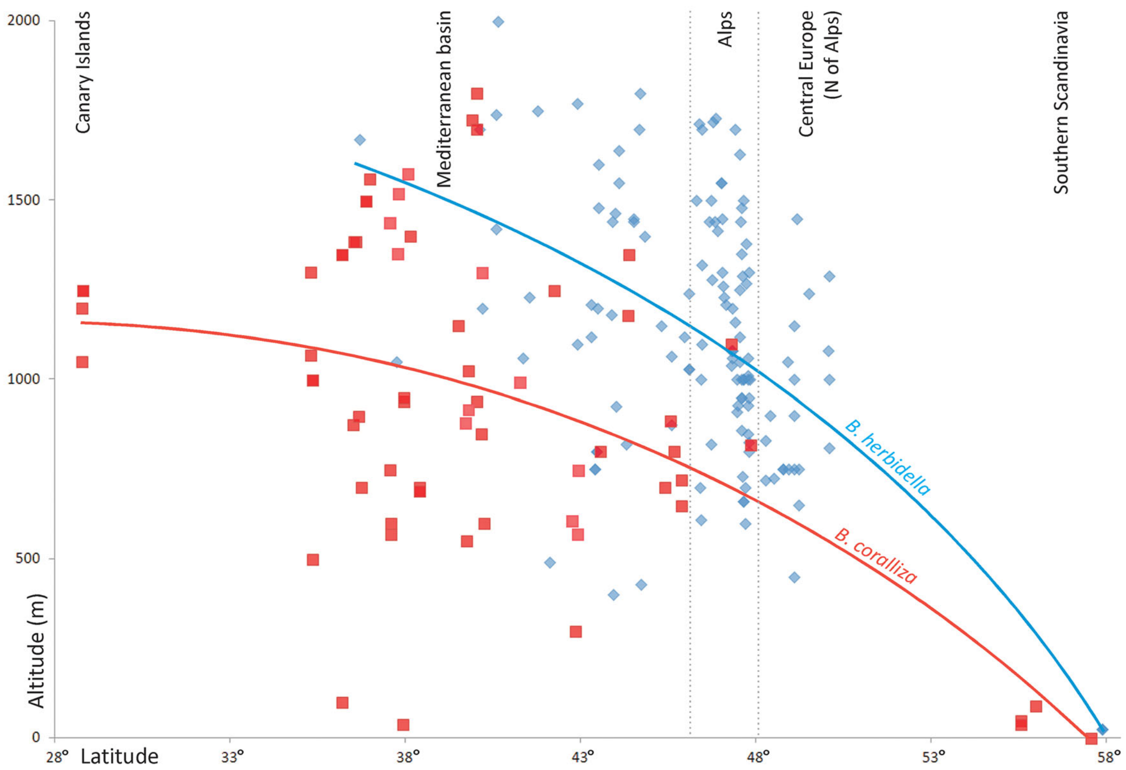


Fig. 11. Latitude/altitude range of *Blastenia herbidella* (red squares) and *B. coralliza* (blue inclined squares). Trend curves interposed by hand.

dwelling species is *Caloplaca asserigena*; it has also small apothecia, but typically dark brown-red with a rusty tinge, and with negative C-reaction, without 7-chloroemodin (Søchting & Fröberg, 2003).

Note 2: Similar species in arctic-alpine habitats, on organic substrates and with chlorinated anthraquinones in apothecia: *Bryoplaca sinapisperma* (atranorin in thallus detected by spot reaction with KOH, more convex apothecia commonly with brown tinge); *Caloplaca caesiorufella* (apothecia usually below 0.5 mm diam. and ascospores 12–14.5 μm long) and *C. spitsbergensis* (similar to *C. caesiorufella*; see Søchting et al., 2008).

Note 3: Chemotypes with positive hypochlorite reaction in whole apothecial surface may be found also in other epilithic species; we observed it in one specimen of *B. caucasica*.

Note 4: Epiphytic species without vegetative diaspores are very similar to each other. Identification of these specimens is especially complicated in the Iberian Peninsula, where *B. ferruginea* and *B. relicta* are present and *B. lauri* is expected. In addition, in Andalusia we recognized epiphytic population of *B. festivella* (see the taxonomic part) and found specimens of *B. coralliza* without vegetative diaspores (Malíček 5561). We recommend the ITS barcode for recognition of specimens from the Iberian Peninsula.

Note 5: Arctic-alpine *Caloplaca fuscorufa* is similar in common expansion of Cinereorufa-green (sometimes also to apothecial discs), but it has larger ascospores, often more than 15 μm long, and pycnidia are unknown (more about *C. fuscorufa* in Arup et al., 2007).

Note 6: *Blastenia psychrophila* with similar ecology may exceptionally have poorly developed coarse isidia, but it is not distinctly blastidiate/isidiate as *B. scabrosa*. Our newest research in the Caucasus Mts revealed blastidiate populations related to *B. caucasica* (unpublished). We consider this population not morphologically separable from *B. scabrosa*.

Note 7: Generally difficult group; for instance in the Caucasus Mts., several species meet and some species show abnormal phenotype variability. Some specimens cannot be unambiguously recognized and ITS sequencing is recommended.

Note 8: *Gyalolechia epiphyta* is similar to yellow-thallus morphotypes of both *B. anatolica* and *B. monticola* and may grow in the same habitats (Vondrák et al., 2016): it has yellow (or rarely grey) blastidiate thallus, red pycnidia containing chlorinated anthraquinones and apothecia with chlorinated anthraquinones accumulated in exciple. It differs in the usual presence of chlorinated anthraquinones also in the disc and it contains fragilin as a dominant anthraquinone (hardly observed on TLC plates behind the parietin spot; HPLC in need).

Note 9: Arup & Åkelius (2009) distinguished these species by some other characters. They considered *B. coralliza* to be rarely fertile with usually yellow-orange thallus (isidia). This may be true in Scandinavia and the Canary Islands, but numerous Mediterranean specimens are richly fertile and have a grey thallus. For instance, in Sierra de las Nieves Mts. (Spain), where *B. coralliza* is very common in upper montane coniferous forests, the species is rich in apothecia and yellow thalli are only exceptional.

Acknowledgements

Linda in Arcadia substantially improved the manuscript and kindly provided her lichen specimens from Greece. Evgeny Davydov, Josef Hafellner, Zdeněk Palice, Irina Urbanavichene, and Gennadii Urbanavichus generously provided a substantial number of specimens. Pieter van den Boom, František Bouda, Mehmet Candan, Sergey Chesnokov, Steen Christensen, Brian Coppins, Patrik Frödén, Anna Guttová, Josef Halda, Helmut Mayrhofer, Lucia Muggia, Ulrika Nordin, Walter Obermayer, Ivan Pišút, Mark Powell, Claude Roux, Neil Sanderson, Ayhan Şenkardeşler, Harrie Sipman, Mohammad Sohrabi, Toby Spribille, Ulf Schiefelbein, Reinaldo Vargas, and Volkmar Wirth provided additional specimens. Lichen images were made in co-operation with Jiří Machač. Our research received support by a long-term research development grant RVO 67985939, and by the Tübitak project 111T927.

References

Aras S, Cansaran D. 2006. Isolation of DNA for sequence analysis from herbarium material of some lichen specimens. *Turkish Journal of Botany* 30: 449–453.

Arcadia L, Vondrák J. 2017. Proposal to conserve the name Lichen ferrugineus (Blastenia ferruginea) with a conserved type (Teloschistaceae, lichenised Ascomycota). *Taxon* 66: 1467–1468.

Arup U, Arneng E, Søchting U. 2007. Caloplaca fuscorufa – a misunderstood species in northern Europe. *Lichenologist* 39: 409–414.

Arup U, Søchting U, Frödén P. 2013. A new taxonomy of the family Teloschistaceae. *Nordic Journal of Botany* 31: 16–83.

Arup U, Åkelius E. 2009. A taxonomic revision of Caloplaca herbidella and C. furfuracea. *Lichenologist* 41: 465–480.

Clements FE, Shear CL. 1931. *The genera of fungi*. New York: H. W. Wilson Co.

Drummond AJ, Rambaut A. 2007. BEAST: Bayesian evolutionary analysis by sampling trees. *BMC Evolutionary Biology* 7: 214.

Ekman S. 1996. The corticolous and lignicolous species of Bacidia and Bacidina in North America. *Opera Botanica* 127: 1–148.

Elix JA. 2014. *A Catalogue of standardized chromatographic data and biosynthetic relationships for lichen substances*. 3rd edn. Published by the author.

Fedorova ND, Khaldi N, Joardar VS, Maiti R, Amedeo P, Anderson MJ, Crabtree J, Silva JC, Badger JH, Albarraq A, Angiuoli S, Bussey H, Bowyer P, Cotty PJ, Dyer PS, Egan A, Galens K, Fraser-Liggett CM, Haas BJ, Inman JM, Kent R, Lemieux S, Malavazi I, Orvis J, Roemer T, Ronning CM, Sundaram JP, Sutton G, Turner G, Venter JC, White OR, Whitty BR, Youngman P, Wolfe KH, Goldman GH, Wortman JR, Jiang B, Denning DW, Nierman WC. 2008. Genomic islands in the pathogenic filamentous fungus Aspergillus fumigatus. *PLoS Genetics* 4: e1000046.

Frolov I, Konoreva L. 2016. New records of crustose Teloschistaceae (lichens, Ascomycota) from the Murmansk region of Russia. *Polish Polar Research* 37: 421–434.

Gaya E, Fernández-Brime S, Vargas-Castillo R, Lachlan RF, Gueidan C, Ramiréz-Mejia M, Lutzoni F. 2015. The adaptive radiation of lichen-forming Teloschistaceae is associated with sunscreening pigments and a bark-to-rock substrate shift. *Proceedings of the National Academy of Sciences USA* 112: 11600–11605.

Gregory TR. 2005. The C-value enigma in plants and animals: a review of parallels and an appeal for partnership. *Annals of Botany* 95: 133–146.

Hall TA. 1999. BioEdit: a user-friendly biological sequence alignment editor and analysis program for Windows 95/98/NT. *Nucleic Acids Symposium Series* 41: 95–98.

Hudson W. 1762. *Flora Anglica*. London: Londini.

Huelsenbeck JP, Ronquist F. 2001. MRBAYES: Bayesian inference of phylogeny. *Bioinformatics* 17: 754–755.

Katoh K, Kuma K, Toh H, Miyata T. 2005. MAFFT version 5: improvement in accuracy of multiple sequence alignment. *Nucleic Acids Research* 33: 511–518.

Katoh K, Standley DM. 2013. MAFFT multiple sequence alignment software version 7: improvements in performance and usability. *Molecular Biology and Evolution* 30: 772–780.

Knight CA, Ackerly DD. 2002. Variation in nuclear DNA content across environmental gradients: a quantile regression analysis. *Ecology Letters* 5: 66–76.

Kondratyuk SY, Jeong M-H, Yu N-N, Kärnefelt I, Thell A, Elix JA, Kim J, Kondratiuk A, Hur J-S. 2014. A revised taxonomy for the subfamily Caloplacoideae (Teloschistaceae, Ascomycota) based on molecular phylogeny. *Acta Botanica Hungarica* 56: 93–123.

Kondratyuk SY, Kärnefelt I, Elix JA, Thell A. 2009a. Contributions to the Teloschistaceae, with particular reference to the Southern Hemisphere. *Bibliotheca Lichenologica* 100: 207–282.

Kondratyuk SY, Kärnefelt I, Elix JA, Thell A. 2009b. New Caloplaca species from Australia. *Bibliotheca Lichenologica* 99: 259–278.

Kondratyuk SY, Schumm F, Elix JA, Kärnefelt I, Thell A, Hur J. 2017. Eilifdahlia schwarzii (Caloplacoideae, Teloschistaceae) – a new species from Western Australia. *Graphis Scripta* 29: 18–23.

Kullman B, Tamm H, Kullman K. 2005. Fungal Genome Size Database. Available from http://www.zbi.ee/fungal-genomesize [accessed 17 July 2019].

Laundon JR. 1984. The typification of Withering's neglected lichens. *Lichenologist* 16: 211–239.

Lindblom L, Søchting U. 2008. Taxonomic revision of *Xanthomendoza borealis* and *Xanthoria mawsonii* (Lecanoromycetes, Ascomycota). *Lichenologist* 40: 399–409.

Lücking R, Tehler A, Bungartz F, Rivas Plata E, Lumbsch HT. 2013. Journey from the West: Did tropical Graphidaceae (lichenized Ascomycota: Ostropales) evolve from a saxicolous ancestor along the American Pacific coast? *American Journal of Botany* 100: 844–856.

Ma L-J, van der Does HC, Borkovich AK, Coleman JJ, Daboussi MJ, di Pietro A, Dufresne M, Freitag M, Grabherr M, Henrissat B, Houterman PM, Kang S, Shim W-B, Woloshuk C, Xie X, Xu J-R, Antoniw J, Baker SE, Bluhm BH, Breakspear A, Brown DW, Butchko RAE, Chapman S, Coulson R, Coutinho PM, Danchin EGJ, Diener A, Gale LR, Gardiner DM, Goff S, Hammond-Kosack KE, Hilburn K, Hua-van A, Jonkers W, Kazan K, Kodira CD, Koehrsen M, Kumar L, Lee YH, Li L, Manners JM, Miranda-Saavedra D, Mukherjee M, Park G, Park J, Park S-Y, Proctor RH, Regev A, Ruiz-Roldan MC, Sain D, Sakthikumar S, Sykes S, Schwartz DC, Turgeon BG, Wapinski I, Yoder O, Young S, Zeng Q, Zhou S, Galagan J, Cuomo CA, Kistler HC, Rep M. 2010. Comparative genomics reveals mobile pathogenicity chromosomes in Fusarium. *Nature* 464: 367–373.

Magnusson AH. 1944a. Some species of Caloplaca from North America. *Botaniska Notiser* 1944: 63–79.

Magnusson AH. 1944b. Studies in the ferruginea-group of the genus Caloplaca. *Kungliga Vetenskaps- och Vitterhets-samhälles Handlingar, Sjätte Följden, serie B* 3: 3–71.

Magnusson AH. 1951. New or otherwise interesting Swedish lichens XIV. *Botaniska Notiser* 1951: 64–82.

Massalongo A. 1852a. Synopsis Lichenum Blasteniosporum. *Flora (Regensburg)* 35: 561–576.

Massalongo A. 1852b. Monografia dei licheni blasteniospori. *Atti delle Adunanzo dell I. R. Istituto Veneto di Scienze, Lettere ed Arti* 2, 3 (Appendice 3): 5–131.

Meyer B, Printzen C. 2000. Proposal for a standardized nomenclature and characterization of insoluble lichen pigments. *Lichenologist* 32: 571–583.

Mohanta TK, Bae H. 2015. The diversity of fungal genome. *Biological Procedures Online* 17: 8.

Nimis PL. 2016. *The Lichens of Italy – a second annotated catalogue*. Trieste: EUT Edizioni Università di Trieste.

Nylander W. 1873. Observata lichenologica in Pyrenaeis orientalibus. IV. *Collioure. Flora (Regensburg)* 56: 193–205.

Nylander W. 1880. Addenda nova ad Lichenographiam Europaeam. Continuatio quarta et tricesima. *Flora (Regensburg)* 63: 387–394.

Otálora MA, Aragón G, Martínez I, Wedin M. 2013. Cardinal characters on a slippery slope - A re-evaluation of phylogeny, character evolution, and evolutionary rates in the jelly lichens (Collemataceae s. str). *Molecular and Phylogenetic Evolution* 68: 185–198.

Poelt J, Wunder H. 1967. Über biatorinische und lecanorinische Berandung von Flechtenapothecien untersucht am Beispiel der Caloplaca ferruginea-Gruppe. *Botanische Jahrbücher fur Systematik, Pflanzengeschichte und Pflanzengeographie* 86: 256–265.

Posada D. 2008. jModelTest: Phylogenetic model averaging. *Molecular Biology and Evolution* 25: 1253–1256.

Quilhot W, Rubio C, Cuellar M. 2007. Comparative studies between the lichen flora from Chile and Antarctica. *Bibliotheca Lichenologica* 95: 479–488.

Rambaut A, Drummond AJ. 2009. Tree. Available from https://beast.community/treeannotator [accessed 17 July 2019].

Rambaut A, Suchard MA, Xie D, Drummond AJ. 2014. Tracer v1.6. Available from https://beast.community/tracer [accessed 17 July 2019].

Rannala B, Yang Z. 2003. Bayes estimation of species divergence times and ancestral population sizes using DNA sequences from multiple loci. *Genetics* 164: 1645–1656.

Ronquist F, Huelsenbeck JP. 2003. MRBAYES 3: Bayesian phylogenetic inference under mixedmodels. *Bioinformatics* 19: 1572–1574.

Simmons MP, Ochoterena H. 2000. Gaps as characters in sequence-based phylogenetic analyses. *Systematic Biology* 49: 369–381.

Smith CW, Aptroot A, Coppins BJ, Fletcher A, Gilbert OL, James PW, Wolseley PA. 2009. *The lichens of Great Britain and Ireland*. London: British Lichen Society.

Spanu PD, Abbott JC, Amselem J, Burgis TA, Soanes DM, Stüber K, Ver Loren van Themaat E, Brown JK, Butcher SA, Gurr SJ, Lebrun MH, Ridout CJ, Schulze-Lefert P, Talbot NJ, Ahmadinejad N, Ametz C, Barton GR, Benjdia M, Bidzinski P, Bindschedler LV, Both M, Brewer MT, Cadle-Davidson L, Cadle-Davidson MM, Collemare J, Cramer R, Frenkel O, Godfrey D, Harriman J, Hoede C, King BC, Klages S, Kleemann J, Knoll D, Koti PS, Kreplak J, López-Ruiz FJ, Lu X, Maekawa T, Mahanil S, Micali C, Milgroom MG, Montana G, Noir S, O'Connell RJ, Oberhaensli S, Parlange F, Pedersen C, Quesneville H, Reinhardt R, Rott M, Sacristán S, Schmidt SM, Schön M, Skamnioti P, Sommer H, Stephens A, Takahara H, Thordal-Christensen H, Vigouroux M, Wessling R, Wicker T, Panstruga R. 2010. Genome expansion and gene loss in powdery mildew fungi reveal tradeoffs in extreme parasitism. *Science* 330: 1543–1546.

Søchting U. 1997. Two major anthraquinone chemosyndromes in Teloschistaceae. *Bibliotheca Lichenologica* 68: 135–144.

Søchting U. 2001. Chemosyndromes with chlorinated anthraquinones in the lichen genus Caloplaca. *Bibliotheca Lichenologica* 78: 395–404.

Søchting U, Fröberg L. 2003. Caloplaca asserigena, the correct name for a small lichen with a unique chemistry. *Bibliotheca Lichenologica* 86: 47–51.

Søchting U, Lorentsen LB, Arup U. 2008. The lichen genus Caloplaca (Ascomycota, Lecanoromycetes) on Svalbard. Notes and additions. *Nova Hedwigia* 87: 69–96.

Søchting U, Øvstedal DO, Sancho LG. 2004. The lichens of Hurd Peninsula, Livingston Island, South Shetlands, Antarctica. *Bibliotheca Lichenologica* 88: 607–658.

Tehler A, Ertz D, Irestedt M. 2013. The genus *Dirina* (Roccellaceae, Arthoniales) revisited. *Lichenologist* 45: 427–476.

Tripp EA. 2016. Is asexual reproduction an evolutionary dead end in lichens? *Lichenologist* 48: 559–580.

Valný M, Honsa P, Kirdajová D, Kameník Z, Anděrová M. 2016. Tamoxifen in the mouse brain: Implications for fate-mapping studies using the tamoxifen-inducible Cre-loxP system. *Frontiers in Cellular Neuroscience* 10: 243.

Veselská T, Svoboda J, Růžičková Ž, Kolařík M. 2014. Application of flow cytometry for genome size determination in Geosmithia fungi: A comparison of methods. *Cytometry Part A* 85: 854–861.

Vobis G. 1980. Bau und Entwicklung der Flechten-Pycnidien und ihrer Conidien. *Bibliotheca Lichenologica* 14: 1–141.

Vondrák J, Frolov I, Arup U, Khodosovtsev A. 2013a. Methods for phenotypic evaluation of crustose lichens with emphasis on Teloschistaceae. *Chornomorskiy Botanichniy Zhurnal* 9: 382–405.

Vondrák J, Frolov I, Davydov E, Urbanavichene I, Chesnokov S, Zhdanov I, Muchnik E, Konoreva L, Himelbrant D, Tchabanenko S. 2016. The extensive geographical range of several species of Teloschistaceae: Evidence from Russia. *Lichenologist* 48: 171–189.

Vondrák J, Frolov I, Říha P, Hrouzek P, Palice Z, Nadyeina O, Halıcı G, Khodosovtsev A, Roux C. 2013b. New crustose Teloschistaceae in Central Europe. *Lichenologist* 45: 701–722.

Vondrák J, Malíček J. 2015. Teloschistaceae of the localities Velká kotlina and Petrovy kameny in the Hrubý Jeseník Mts. *Bryonora* 56: 45–55.

Vondrák J, Wirth V. 2013. Caloplaca. In: Wirth V, Hauck M, Schultz M eds. *Die Flechten Deutschlands*. Stuttgart: Ulmer. 262–317.

Vondrák J, Říha P, Arup U, Søchting U. 2009. The taxonomy of the Caloplaca citrina group (Teloschistaceae) in the Black Sea region: with contributions to the cryptic species concept in lichenology. *Lichenologist* 41: 571–604.

Vondrák J, Šoun J, Vondráková O, Fryday AM, Khodosovtsev A, Davydov E. 2012. Absence of anthraquinone pigments is paraphyletic and a phylogenetically unreliable character in the Teloschistaceae. *Lichenologist* 44: 401–418.

Wakamiya I, Newton RJ, Spencer Johnston J, James Price H. 1993. Genome size and environmental factors in the genus Pinus. *American Journal of Botany* 80: 1235–1241.

Weddell HA. 1873. Nouvelle revue des lichens du jardin public de Blossac, à Poitiers. *Mémoires de la Société des Sciences Naturelles de Cherbourg* 17: 353–373.

Wetmore CM. 1996. The Caloplaca sideritis group in North and Central America. *Bryologist* 99: 292–314.

Wetmore CM. 2004. The isidiate corticolous Caloplaca species in North and Central America. *Bryologist* 107: 284–292.

Wilk K. 2015. Four species of Caloplaca s.l. (Lichenized Ascomycota, Teloschistaceae) new for Poland. *Polish Botanical Journal* 60: 197–201.

Yang Z. 2015. The BPP program for species tree estimation and species delimitation. *Current Zoology* 61: 854–865.

Yang Z, Rannala B. 2010. Bayesian species delimitation using multilocus sequence data. *Proceedings of the National Academy of Sciences USA* 107: 9264–9269.

Yang Z, Rannala B. 2014. Unguided species delimitation using DNA sequence data from multiple loci. *Molecular Biology and Evolution* 31: 3125–3135.

Yuen K-Y, Pascal G, Wong SSY, Glaser P, Woo PCY, Kunst F, Cai JJ, Cheung EYL, Médigue C, Danchin A. 2003. Exploring the Penicillium marneffei genome. *Archives of Microbiology* 179: 339–353.

Supplementary Material

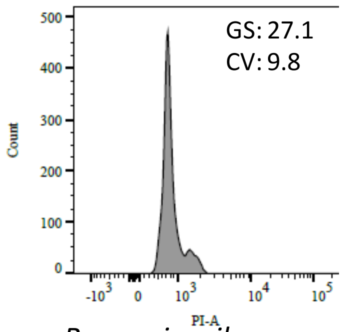
The following supplementary material is available online for this article at http://onlinelibrary.wiley.com/doi/10.1111/jse.12503/suppinfo:

Fig. S1. Examples of fluorescence intensity histograms for all measured Blastenia species. Minor peaks represent G2 phase of cell cycle. GS, mean genome size [Mb]; CV, mean coefficient of variation of fluorescent intensity histograms [%].

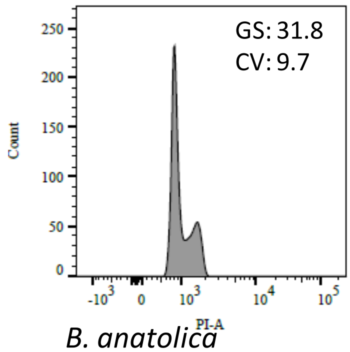
Table S1. List of studied specimens ordered by species names.

Table S2. Results of flow cytometry measurements.

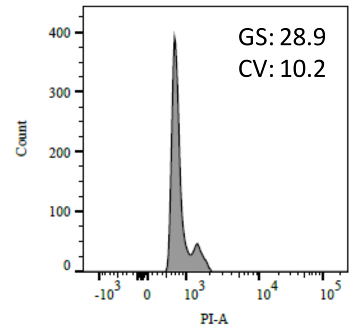
Table S3. Secondary metabolites revealed by mass spectrometry in the negative electrospray ionization (ESI).



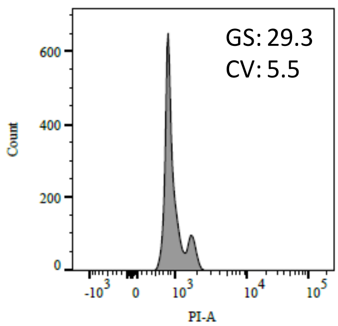
B. ammiospila



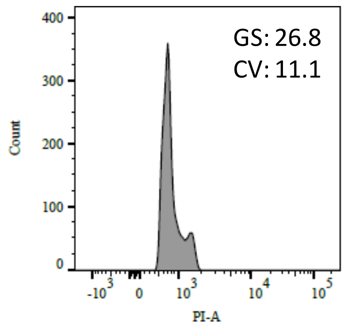
B. anatolica



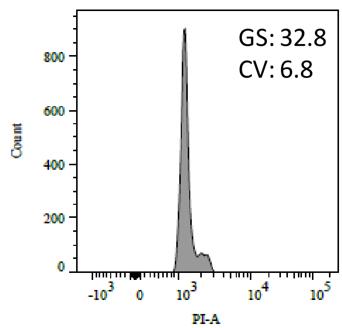
B. catalinae



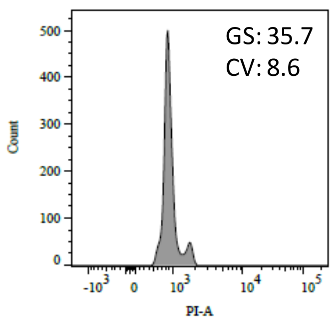
B. caucasica



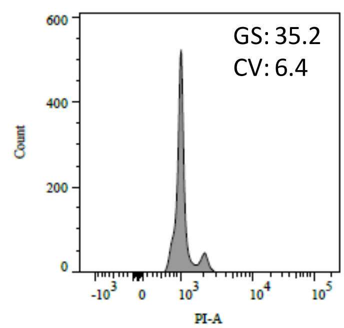
B. coralliza



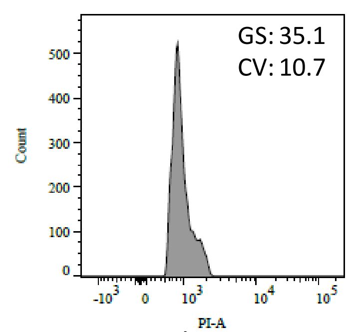
B. crenularia



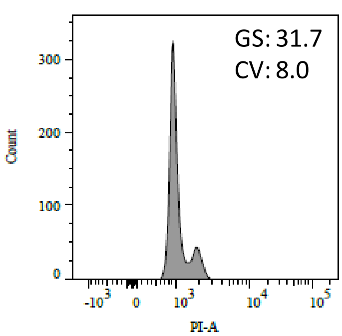
B. crenularia



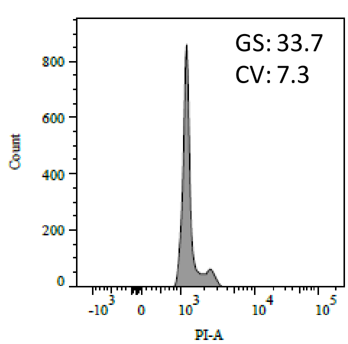
B. crenularia



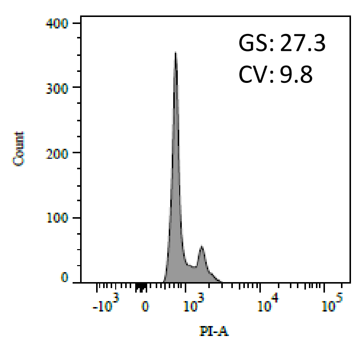
B. crenularia



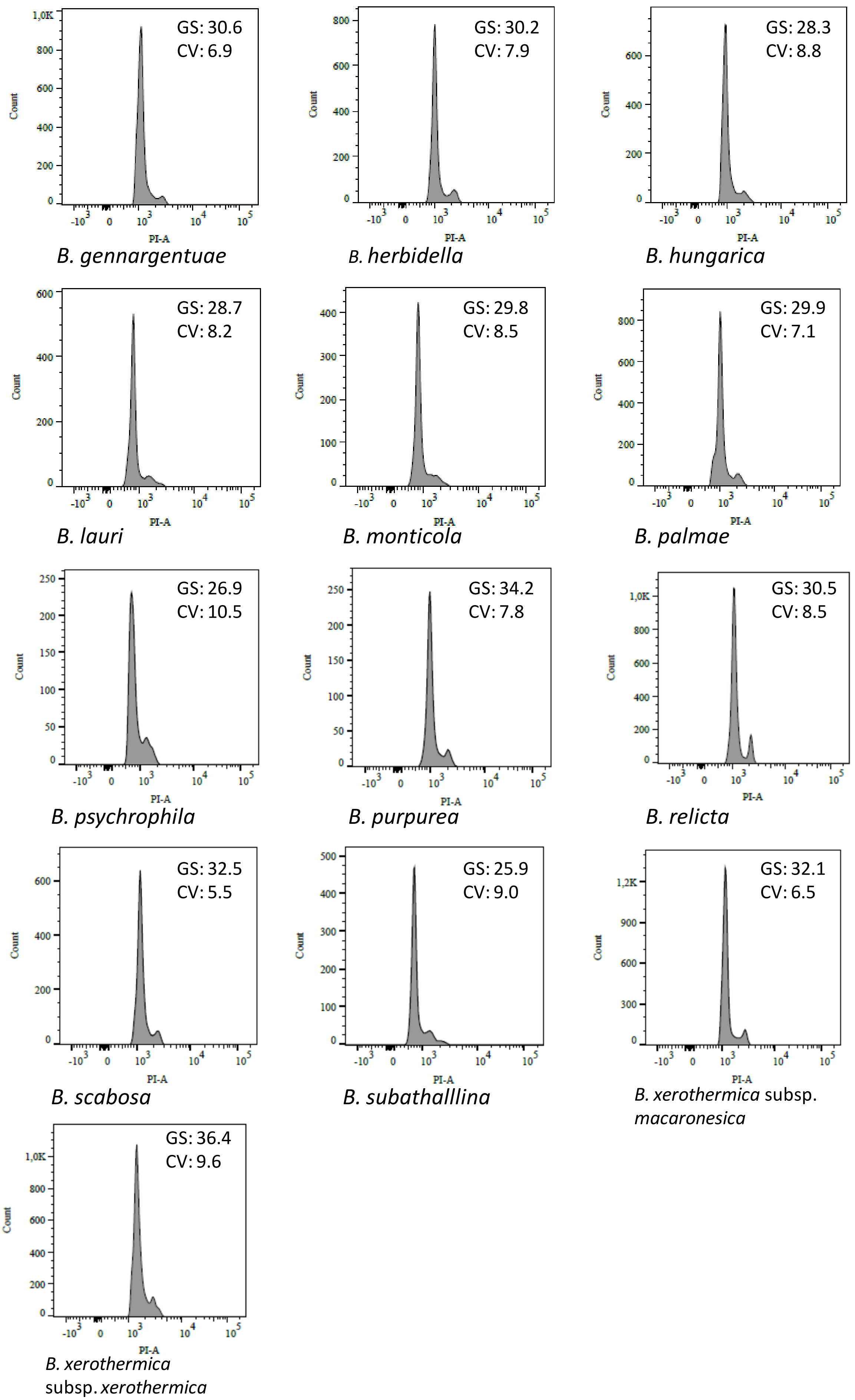
B. ferruginea



B. festivella



B. furfuracea


GS: 30.6
CV: 6.9
B. gennargentuae
GS: 30.2
CV: 7.9
B. herbidella
GS: 28.3
CV: 8.8
B. hungarica
GS: 28.7
CV: 8.2
B. lauri
GS: 29.8
CV: 8.5
B. monticola
GS: 29.9
CV: 7.1
B. palmae
GS: 26.9
CV: 10.5
B. psychrophila
GS: 34.2
CV: 7.8
B. purpurea
GS: 30.5
CV: 8.5
B. relicta
GS: 32.5
CV: 5.5
B. scabosa
GS: 25.9
CV: 9.0
B. subathalllina
GS: 32.1
CV: 6.5
B. xerothermica subsp. macaronesica
GS: 36.4
CV: 9.6
B. xerothermica subsp. xerothermica
Count
PI-A

Supplementary table 1. List of studied specimens ordered by species names. Sequenced specimens are listed with priority, but non-sequenced specimens are also listed below.

taxon	herbarium accession	Short locality description (country, closest larger town/city)	altitude (m)	longitude	latitude	substrate	ITS	mtLSU	β-tubulin
afroalpina	GZU - Miehe U09-10701	Uganda, Mt Elgon	4100	34,51666667	1,133333333	twigs of Erica trimera	MF114602	MF114864	MF114997
ammiospila	PRA - Vondrák 10223 (PRA)	Russia, Altai Mts	2500	88,9	50,61666667	plant debris in siliceous rock crevice	MF114715	MF114939	MF115073
ammiospila	ERC - Halıcı CL153	Turkey, Giresun, Şebinkarahisar, South of Eğribel Pass	2275	38,40305556	40,46138889	plant debris	MF114770	MF114972	MF115108
ammiospila	Ivan Frolov 640	Russia, Kola peninsula, Nikel'	100	30,03333333	69,33333333	wood bridge construction	MF114749	MF114962	MF115099
ammiospila	PRA - Vondrák 13637 (599)	Czech Republic, Hrubý jeseník Mts, Petrovy kameny	1420	17,233822	50,06844	muscicolous in alpine zone	MF114747	MF114958	MF115095
ammiospila	PRA - Vondrák 13638 (598)	Czech Republic, Hrubý jeseník Mts, Petrovy kameny	1420	17,233822	50,06844	base-rich gneiss in alpine zone	MF114746	MF114957	MF115094
ammiospila	PRA - Vondrák 10613	Slovakia, Malá Fatra Mts	1590	19,05	49,18333333	Dryas octopetala and plant debris	MF114721	MF114944	
ammiospila	PRA - Vondrák 13163 (605)	Russia, Ural Mts, Katav-Ivanovsk	1150	58,31	54,513056	Juniperus sibirica wood		MF114960	MF115097
ammiospila	LD - Arup L03552	Sweden, Lycksele Lappmark,	510	14,75916667	65,84972222	Salix myrsinifolia	EF643515		
ammiospila	LD - Arup L04076	Sweden, Lule Lappmark,	845	16,65666667	67,2425	Mosses rock	EF643516		
ammiospila	C - Søchting 9345	Austria, Steiermark, Eisenerz	1850	14,95666667	47,53333333	Detritus	KC179413		
ammiospila	PRA - Vondrák 11096	Russia, W Sayan Mts	1490	90,06666667	51,61666667	Larix wood stump	MF114756		
ammiospila	C - Søchting 11556	Antarctica, Loubet Coast, Rothera Point	250	-68,153	-67,557	moss in crevice	MF114846		
ammiospila	LD - Arup L02101	Sweden. Jämtland, Undersåker, Välliste	1010	13,13805556	63,27111111	mosses onamphibolite boulder	MF114798		
ammiospila	LD - Arup L02142	Sweden. Jämtland: Åre	880	12,42777778	63,595	lichen	MF114825		
ammiospila	LD - Frödén 1909	Sweden. Dalarna: Mora	600	14,50491	60,999179	Populus tremula	MF114827		
ammiospila	C - Søchting 10486	Greenland, Narssarssuaq	300	-45,39833333	61,15666667	moss N-exposed, vertical rock	MF114837		
ammiospila	C - Søchting 11554_4304	Antarctica, Loubet Coast, Rothera Point	250	-68,153	-67,557	soil and detritus in crevices	MF114839		
ammiospila	C - Søchting 11555_4306	Antarctica, Loubet Coast, Rothera Point	250	-68,153	-67,557	moss in crevice	MF114840		
ammiospila	C - Søchting 11559_4312	Antarctica, Loubet Coast, Rothera Point	250	-68,153	-67,557	moss in crevice	MF114841		
ammiospila	GZU - Steiner 946	Austria, Styria, Wölzer Tauern, Lachtal	1920	14,33333333	47,25	Rhododendrferrugineum	MF114603		
ammiospila	PRA - Genadii Urbanavichus PAZ-15-08-01 (F40)	Russia, Murmansk region, Pasvik Reserve	69	29,459765	69,289161	trunk of Salix	MF114765		MF115127
anatolica	ERC - Halıcı CL82	Turkey, Kayseri, Talas, Ali Mountain,	1680	35,55416667	38,65861111	Pinus nigra bark	MF114794	MF114983	MF115122
anatolica	ERC - Halıcı CL28	Turkey, Konya, Gevne Valley, İshaklı Plain	1925	32,37055556	36,85055556	wood Pinus nigra	MF114780, MF114781	MF114974	MF115110
anatolica	Ivan Frolov 675 (311)	Abkhazia, Caucasus Mts, NP Ritsinskiy	1535	40,65027778	43,50638889	trunk of Abies nordmanniana	MF114688	MF114925	MF115053
anatolica	ERC - Halıcı CL356	Turkey, Bursa, Uludağ, Hotel area	1960	29,1275	40,1	wood Abies nordmanniana	MF114785		
anatolica	PRA - Palice 21647	Russia, Caucasus Mts, Maykop, plato Lagonaki	1840	40,014	44,07777	trunk of Abies nordmanniana	MF114849		
catalinae	PRA - Vondrák 7488 (108, 125)	USA, California, San Francisco	15	-123,0147222	37,99694444	on coastal shrub	MF114601	MF114863	MF114996

catalinae	Ivan Frolov 1237 (F55)	USA, California, Santa Ynez Mts	580	-119,828944	34,521037	twigs	MF114809	MF114991	MF115134
catalinae	Ivan Frolov 1238 (F56)	USA, California, Santa Ynez Mts	580	-119,828944	34,521037	twigs	MF114810		MF115135
catalinae	J. Klepsand (JK14-1130 pers. herb.) U2183	USA, California, Monterey	50	-121,288325	36,288325	branch of Quercus agrifolia	MF447187		
catalinae	J. Klepsand (JK14-1130 pers. herb.) U2184	USA, California, Monterey	50	-121,288325	36,288325	branch of Quercus agrifolia	MF447188		
caucasica	Ivan Frolov 670 (259)	Abkhazia, Caucasus Mts, NP Ritsinskiy	1990	40,69111111	43,48166667	vertical surface of big base rich siliceous stones	MF114659	MF114904	MF115026
caucasica	Ivan Frolov 676 (260)	Abkhazia, Caucasus Mts, NP Ritsinskiy	2050	40,68194444	43,47472222	big base rich siliceous stone, under overhang	MF114660	MF114905	MF115027
caucasica	Ivan Frolov 674 (261)	Abkhazia, Caucasus Mts, NP Ritsinskiy	2050	40,58055556	43,52333333	base rich siliceous outcrops	MF114661	MF114906	MF115028
caucasica	Ivan Frolov 763a (pale apothecia, dark thallus)	Abkhazia, Caucasus Mts, NP Ritsinskiy	1990	40,68333333	43,48333333	vertical side of base-rich siliceous rock, above tree line	MF114691	MF114927	MF115055
caucasica	Ivan Frolov 763b (dark apothecia, pale thallus)	Abkhazia, Caucasus Mts, NP Ritsinskiy	1990	40,68333333	43,48333333	vertical side of base-rich siliceous rock, above tree line	MF114692	MF114928	MF115056
caucasica	Ivan Frolov 763c (whole apothecium C+ positive)	Abkhazia, Caucasus Mts, NP Ritsinskiy	1990	40,68333333	43,48333333	vertical side of base-rich siliceous rock, above tree line	MF114693	MF114929	MF115057
circumpolaris s.lat.	Reinaldo Vargas 3719a	Chile, IX Region, Alto Bio Bio	NA	-70,96	-38,63	epiphyte	MF114845		
circumpolaris s.lat.	Reinaldo Vargas 3708	Chile, IX Region, Alto Bio Bio	NA	NA	NA	epiphyte	MF114847		
circumpolaris s.str.	C - Søchting 11350	Chile, Cape Froward	10	-71,118	-53,848	Bark of Nothofagus betuloides	MF114696	MF114933	MF115061
circumpolaris s.str.	LD - Frödén 1479	Australia, Victoria, E of Portland, Fitzroy River	?	141,7622222	-38,22166667	Acacia in a grove	KC179414		
circumpolaris s.str.	C - Søgaard 63_2369	Chile, XII Region, Punta Arenas	339	-71,02388889	-53,16222222	Bark of Nothofagus	MF114650		
circumpolaris s.str.	C - Søgaard 69_2373	Chile, XII Region, Isla Navarino	171	-67,63861111	-54,95277778	Stone in forest floor	MF114651		
circumpolaris s.str.	C - Søgaard 74_2436	Chile, XII Region, Isla Navarino	2	-67,19333333	-54,96138889	Dead Nothofagus	MF114652		
circumpolaris s.str.	C - Søchting 11663_E4203B	Australia, Tasmania, Craddle Mts.	700	146,066	-41,537	Dead Eucalyptus trees	MF114842		
coralliza	LD - Arup	Sweden, Skåne, Genarp, Häckeberga	50	13,42833333	55,58	Fraxinus excelsior	FJ866790		
coralliza	LD - Arup	Sweden, Skåne, Torup	40	13,20916666	55,565	Fraxinus excelsior	FJ866791		
coralliza	LD - Arup U744, holotype	Sweden, Skåne, Knutstorp	90	13,13416667	55,98111111	Quercus robur	FJ866792		
coralliza	B - Zedda S373	Syria, Muhafazat, Lattakia	1350	35,58333333	36,195	Juniperus drupacea	FJ866793		
coralliza	B - Zedda S427	Syria, Muhafazat, Lattakia	1350	35,58333333	36,195	Quercus cerris	FJ866794		
coralliza	B - Sipman 49018	Greece, Nomos Samos, Ikaria Island	750	26,16666667	37,58333333	Quercus coccifera	FJ866795		
coralliza	Toby Spribille 13327	Greece, Crete, Levka Ori	1070	24,03333333	35,3	Pinus brutia	FJ866796		
coralliza	Toby Spribille 13400	Greece, Crete, Western Crete, Elos	500	23,63444444	35,3625	Castanea sativa	FJ866797		
coralliza	GZU - Hafellner 58311	Italy, Parma, Emilia Romagna	1350	10,04888889	44,38666667	Fagus silvatica	FJ866798		
coralliza	SAV - Guttová 48S	Tunisia, Kroumirie Mts, Ain Soltane	876	8,333333333	36,51666667	Quercus	MF114703	MF114937	MF115069
coralliza	PRA - Vondrák 12114 (150)	Spain, Canary Islands, La Palma, Barlovento, Los Sauces	1200	-17,81444444	28,785	twigs of Pinus canariensis	MF114630	MF114887	MF115013
coralliza	Jiří Malíček 6751	Italy, Sardinia, Gavoi	850	9,185555556	40,18861111	Quercus pubescens	MF114704, MF114705	MF114938	MF115070

coralliza	ERC - Halıcı CL869	Turkey, Antalya, Alanya, Mahmutlar, northwest of Gümüşyayla	1385	32,59083333	36,58916667	Abies cilicica	MF114796		
coralliza	PRA - Vondrák 10876	Italy, Calabria, Melito do Porto Salvo	40	15,68333333	37,95	Quercus cerris	MF114699		MF115064
coralliza	Jiří Malíček 5561	Spain, Andalusia, Sierra de las Nieves, Tolox	900	-4,95	36,68333333	Pinus pinaster	MF114637, MF114643	MF114897	MF115016, MF115020
coralliza	PRA - Vondrák 12115 (151)	Spain, Canary Islands, La Palma, Barlovento, Los Sauces	1050	-17,81444444	28,785	twigs of Pinus canariensis	MF114631	MF114888	
coralliza	PRA - Vondrák 12577	Turkey, Osmaniye, Zorkun	1560	36,36666667	36,98333333	bark of Pinus nigra	MF114671		
coralliza	Linda in Arcadia 28-Sept-2010/30	Greece, Pelopponese, Vasiliki forest	1500	22,329167	36,895833	Abies cephalonica	MF114717		
coralliza	B 600192787 (coll. Sipman)	Greece, East Aegean Islands, Chios	690	26,036667	38,424333	branch of Juniperus sabina	MF114732		
coralliza	Jiří Malíček 9414	Croatia, Velebit Mts, Paklenica NP	1180	15,462558	44,364948	Fagus sylatica	MF114854		
coralliza	PRA - Vondrák 17904	Spain, Ronda, Sierra de las Nieves	1700	-5,02427	36,68848	trunk of Abies pinsapo	MF447206		
coralliza	Ivan Frolov 1693	Greece, Mt Olympus	1500	22,3871153	40,0816589	on base of trunk of Pinus heldreichii	MF447221		
coralliza	Ivan Frolov 1607	Albania, NP Llogara	1200	19,591447	40,198702	on trunk of Pinus nigra	MF447220		
coralliza	Ivan Frolov 1609	Albania, NP Llogara	1300	19,591447	40,198702	on Crataegus sp.	MF447217		
crenularia	PRA - Vondrák 8785	Bulgaria, Stará planina, Novi Iskar	580	23,35	42,83333333	inland siliceous rock	MF114759	MF114968	MF115105
crenularia	PRA - Vondrák 12567 (288)	Great Britain, Scotland, Oban, Kilmartin	50	-5,486111111	56,13333333	wooden fence	MF114675	MF114915	MF115039
crenularia	PRA - Vondrák 12575 (293)	Turkey, Hatay, Arsuz, Samandağ	220	35,79333333	36,32416667	inland schist outcrops in Mediterranean scrub	MF114680	MF114919	MF115044
crenularia	PRA - Vondrák 12578 (292)	Turkey, Gaziantep, Nurdağı	1300	37,10638889	37,12416667	basalt rock in steppe	MF114679	MF114918	MF115043
crenularia	PRA - Vondrák 12582 (291)	Danmark, Faroe Islands, Kaldbak, Mt Sornfelli	250	6,815277778	62,07083333	inland siliceous rock	MF114678	MF114917	MF115042
crenularia	PRA - Vondrák 13100 (511)	Portugal, Madeira, Pico do Gato	1700	-16,933149	32,739043	alpine volcanic rock	MF114723	MF114946	
crenularia	PRA - Vondrák 13105 (513)	Portugal, Madeira, Pico da Fonte do Bispo	1250	-17,183689	32,796111	montane volcanic rock	MF114725		MF115079
crenularia	PRA - Vondrák 9177 (96)	Czech Republic, Bohemian karst, Karlštejn	230	14,18333333	49,91666667	inland basaltic rock	MF114764		MF115107
crenularia	Ivan Frolov 943	Italy, Sicily, about 20 Km NW of Mt Etna	830	14,83888889	37,85055556	inland volcanic outcrop	MF114706		MF115071
crenularia	Ivan Frolov 944	Italy, Regio di Calabria, Gambarie	1250	15,8475	38,09333333	inland siliceous rock	MF114707		MF115072
crenularia	ERC - Halıcı CL438	Turkey, Çanakkale, Bayramiç- Çan, Bezirganlar Village	225	26,71972222	39,89277778	inland siliceous rock	MF114787		MF115113
crenularia	PRA - Vondrák 8718	Greece, Peloponnese, Argolis Peninsula, Thermisia	50	23,390545	37,417319	coastal volcanic stone	MF114808		MF115133
crenularia	C - Søchting 7523	Iceland, Stödvarfjördur	5	-13,81666667	65,83333333	coastal sandstone rock	KC179415, MF114735,		
crenularia	LD - Arup L97387	Sweden, Bohuslän, Älgön	2	11,72396	57,9226	siliceous seashore rocks	AF353965		
crenularia	LD - Arup L02729	Sweden, Halland, Fjärås, Tjolöholm	1	12,09432	57,400028	siliceous boulder at shore	EF643511		
crenularia	LD - Arup L01935	Sweden, , Halland, Svartrå, Sumpafallen	60	12,65843	57,09314	inland siliceous rock	EF643512		
crenularia	BCN (coll. Gaya)	Sweden, Bohuslän, Kungshamn par., Sunnerskär	5	11,23333333	58,31666667	coastal siliceous rock	JQ301661		
crenularia	PRA - Vondrák 2065	Bulgaria, E Rhodopes, Madzharovo	200	25,85	41,65	inland siliceous rock	KC416112		

crenularia	PRA - Vondrák 5608	Iran, Tabríz, Khalkhal	1900	48,73333333	37,6	inland siliceous rock	KC416115
crenularia	PRA - Vondrák 6409	Hungary, Eger, Szarvaskő	300	20,31666667	47,98333333	inland volcanic rock	KC416117
crenularia	PRA - Vondrák 4137	Greece, Crete, Ano Viannos	250	25,5	35	inland volcanic rock	KC416119
crenularia	PRA - Vondrák 6064	Turkey, Black Sea coast, Giresun	10	38,63333333	40,96666667	coastal siliceous rock	KC416118
crenularia	PRA - Vondrák 17837 (70)	Spain, Canary Islands, Tenerife	2000	-16,46666667	28,35	inland volcanic rock	MF114755
crenularia	PRA - Vondrák 1254 (80)	Slovakia, Krupina, Cerovo	370	19,11666667	48,21666667	inland andesitic rock	MF114757
crenularia	PRA - Vondrák 5819 (84)	Iran, Tabríz, Namin	1350	48,56666667	38,41666667	inland siliceous rock	MF114758
crenularia	ERC - Halıcı CL272	Turkey, Kırklareli, Demirköy	290	27,74972222	41,81861111	inland siliceous rock	MF114778
crenularia	ERC - Halıcı CL823	Turkey, Samsun, Center, South of Özören Village	300	36,11472222	41,39972222	inland siliceous rock	MF114775, MF114793
crenularia	ERC - Halıcı CL2062	Turkey, Izmit, Karamürsel, Tabakhan	65	29,64583333	40,69	inland siliceous rock	MF114768
crenularia	ERC - Halıcı CL1323	Turkey, Sinop, Durağan	795	35,125	41,48666666	inland siliceous rock	MF114769
crenularia	ERC - Halıcı CL2085	Turkey, Manisa	1480	28,53533333	39,91666666	inland siliceous rock	MF114776
crenularia	Ayhan Şenkardeşler, s.n.	Turkey	?	NA	NA	siliceous rock	MF114848
crenularia	Mohammad Sohrabi 3674_776	Iran, East Azerbaijan, Kaleybar	1820	46,78333333	38,88333333	montane siliceous rock	MF114820
crenularia	Mohammad Sohrabi 4022_1566	Iran, East Azerbaijan, Kaleybar	1820	46,78333333	38,88333333	montane siliceous rock	MF114821
crenularia	ERC - Halıcı CL2007	Ankara, Çamlıdere	1180	32,46666667	40,45	inland siliceous rock	MF114774
crenularia	ERC - Halıcı CL1840	Turkey, Yalova, Armutlu, Esenköy	50	28,88333333	40,58333333	coastal siliceous rocks	MF114773
crenularia	ERC - Halıcı CL398	Turkey, Bartın, Kurucaşile, Karaman	215	32,63333333	41,81666667	coastal siliceous rocks	MF114767
crenularia	Coppins, s.n. (coll. 6 July 2014)	Great Britain, Isle of Man, Calf of Man	90	-4,833333333	54,03333333	coastal siliceous rock	MF114654
crenularia	Coppins, s.n. (coll. 13 Aug. 2014)	Great Britain, Scotland, Outer Hebrides, Shiant Islands	60	-6,35	57,88333333	coastal siliceous rock	MF114653
crenularia	SAV - Pišút s.n. (A3-63) 490	Greece, Andros	?	24,89	37,86	hard clay soil	MF114714
crenularia	Claude Roux s.n. (27.4.2013) (480)	France, Charente-Maritime	10	-0,8486	45,913	dust impregnated wood	MF114709
crenularia	PRA - Vondrák 17848	Spain, Asturias, Moral	1650	-6,4217	43,00069	schist outcrop in pasture	MF447192
crenularia	PRA - Vondrák 17899	Spain, Galicia, Porto do Barqueiro	100	-7,68131	43,78541	granite cliff at sea shore	MF447204
crenularia	PRA - Vondrák 18020	Spain, Andalusia, Tarifa	270	-5,71681	36,08632	sandstone	MF447210
crenularia	PRA - Vondrák 17880	Spain, Ronda, Sierra de las Nieves	1300	-5,042	36,693	sandstone	MF447211
crenularia	PRA - Vondrák 17875	Spain, Andalusia, Tarifa, Bolonia	250	-5,794101	36,099444	sandstone	MF447212
crenularia	PRA - Vondrák 17883	Spain, Andalusia, Tarifa	220	-5,718031	36,082035	sandstone	MF447213
crenularia	PRA - Vondrák 17865	Spain, Andalusia, Tarifa	380	-5,722888	36,085575	sandstone	MF447214
crenularia	PRA - Vondrák 17869	Spain, Andalusia, Tarifa	220	-5,718031	36,082035	sandstone	MF447215

crenularia	PRA - Vondrák 17877	Spain, Andalusia, Tarifa, Bolonia	250	-5,794101	36,099444	sandstone	MF447216		
crenularia	Ulf Schiefelbein 2743	Germany, Rügen island	0	13,66666667	54,4	granite boulder at coast	MF114657		
ferruginea	Jiří Malíček 5605	Spain, Andalusia, Jimena de la Frontera	60	-5,466666667	36,43333333	twig of Olea europaea	MF114638	MF114892	MF115017
ferruginea	Ivan Frolov 991 (575)	Spain, Andalusia, NP Los Alcornocales	600	-5,6355	36,518389	Olea europea	MF114738	MF114952	MF115087
ferruginea	Ivan Frolov 999 (576)	Spain, Catalonia, Santa Maria de Montserrat Abbey	1100	1,811417	41,605083	twigs of Quercus ilex	MF114739	MF114953	MF115088
ferruginea	Ivan Frolov 995	Spain, Andalusia, Cádiz, NP Los Alcornocales	600	-5,6355	36,518389	Quercus suber	MF114736		MF115085
ferruginea	Ivan Frolov 966 (574)	France, Gorges Du Verdon	850	6,317	43,762944	Pistacia terebinthus	MF114737	MF114951	MF115086
ferruginea	Jiří Malíček 7427	Italy, Sicily, Nebrodi Mts	940	14,61666667	37,96666667	Quercus cerris	MF114682		MF115046
ferruginea	Neil Sanderson1994 (164, 275)	Great Britain, Hampshire, New Forest	60	-1,623995	50,856821	old Fagus sylvatica	MF114641, MF114668	MF114895, MF114912	MF115035
ferruginea	Mark Powell 3457	Great Britain, London, Holland Park	40	-0,25	51,5	Quercus sp.		MF114934	MF115065
ferruginea	GZU - Mayrhofer 16051	Slovenia, Sočerga	360	13,88333333	45,46666667	Quercus pubescens	MF114615	MF114874	
ferruginea	PRA - Vondrák 7224 (R243)	Crimea, Karadag	50	35,18333333	44,9	bark	MF114818		
ferruginea	PRA - Vondrák 7256	Croatia, Poreč	30	13,58333333	45,23333333	Quercus cerris	MF114819		
ferruginea	PRA - Vondrák 7959 (88)	Croatia, Gradac	600	17,35	43,1	Acer campestre		MF114969	
ferruginea	MA - Lichen13183 (coll. Etayo) DNA:S2	Spain, Huesca, Atarés	740	-0,6	42,6	Quercus pyrenaica	MF447185		
ferruginea	LD (Fritz 1912)	Italy, Lazio, Lago di Vico	510	12,149124	42,322253	Fraxinus ornus	MF447186		
ferruginea	PRA - Vondrák 17854	Spain, Asturias, Moral	750	-6,54047	43,06823	trunk of Quercus pubescens	MF447195		
festivella	PRA - Vondrák 12647 (black exciple)	Spain, Canary Islands, Tenerife	300	-16,14916667	28,57333333	volcanic rock	MF114753	MF114966	MF115102
festivella	PRA - Vondrák 12648 (red exciple)	Spain, Canary Islands, Tenerife	300	-16,14916667	28,57333333	volcanic rock	MF114754	MF114967	MF115103
festivella	ERC - Halıcı CL34	Turkey, İstanbul, Burgazada	0	29,06805556	40,88472222	siliceous rock	MF114783	MF114975	MF115111
festivella	PRA - Vondrák 12588 (296)	Portugal, Lisbon, Malveira da Serra, Biscaia	50	-9,476111111	38,75388889	coastal granite cliff	MF114681	MF114920	MF115045
festivella	PRA - Vondrák 12122 (pale) (141)	Spain, Canary Islands, La Palma, Santa Cruz de La Palma	1050	-17,81777778	28,64472222	artificial volcanic outcrop in road cutting	MF114621	MF114879	MF115006
festivella	PRA - Vondrák 13106 (512)	Portugal, Madeira, Machico	30	-16,715211	32,743061	maritime volcanic rock	MF114724	MF114947	MF115078
festivella	PRA - Vondrák 13098 (515)	Portugal, Madeira, Machico	100	-16,765638	32,712614	base of Euphorbia	MF114727	MF114949	MF115081
festivella	PRA - Vondrák 13111 (508)	Portugal, Madeira, Curral das Freiras	650	-16,968415	32,713524	inland volcanic rock	MF114719	MF114942	MF115075
festivella	PRA - Vondrák 13736a	Portugal, Madeira, Ponta de Sao Lourenco	60	-16,687061	32,745537	on volcanic rock at sea shore	MF114799	MF114987	MF115128
festivella	PRA - Vondrák 13736b (black apothecial margin)	Portugal, Madeira, Ponta de Sao Lourenco	60	-16,687061	32,745537	on volcanic rock at sea shore	MF114800	MF114988	MF115129
festivella	PRA - Vondrák 13733	Portugal, Madeira, Porto Moniz	30	-17,168266	32,867391	on volcanic rock at sea shore	MF114803	MF114989	MF115130
festivella	van den Boom 25968	Spain, Canary Islands, Fuerteventura	440	-14,38333333	28,08333333	volcanic rock		MF114930	MF115058
festivella	PRA - Sel. Cal. Exs. 37 (116)	Spain, Andalucia, Tarifa	250	-5,716849	36,085533	Eucalyptus	MF114608, MF114702		MF115068

festivella	PRA - Vondrák 12569 (279)	Portugal, Lisbon, Ericeira, Ribamar	40	-9,424722222	38,99638889	sandstone boulder at coast	MF114670		MF115036
festivella	PRA - Vondrák 13736c (black ap. margin and disc)	Portugal, Madeira, Ponta de Sao Lourenco	60	-16,687061	32,745537	on volcanic rock at sea shore	MF114801		
festivella	PRA - Vondrák 6255	Spain, Punta Falconera	0	3,2	42,21666667	coastal siliceous rock	KC416114		
festivella	Roux 26046	France, Provence, Bouches-du-Rhone	10	5,5975	43,16702	maritime siliceous rock	MF114711		
festivella	B 600194480 (coll. Sipman)	Greece, East Aegean Islands, Chios	200	25,865	38,56	siliceous stone of wall	MF114731		
festivella	PRA - Vondrák 13732	Portugal, Madeira, Ponta do Pargo	200	-17,249187	32,803004	on volcanic rock at sea shore	MF114804		
festivella	GZU - Mayrhofer 18045	Greece, Crete, Platanos	220	23,58333333	35,45	siliceous rock, granite	KC416113		
festivella	Franz Berger 15740	Portugal, Azores, Sao Gorge, Velhas, Punta das Eiras	10	28,21166667	38,68	Basalt rocks near shore	KC179418		
furfuracea	LD - Nordin 2546 (266)	Sweden, Jämtland, Ovikem	330	14,31305556	63,04833333	bark of Betula	FJ866812, MF114816	MF114910	MF115032
furfuracea	ALTB - Davydov 11241	Russia, Altai Mts	870	82,975	51,18583333	Betula tortuosa	MF114687	MF114924	MF115052
furfuracea	LD - Johnsson 2510 (265)	Sweden, Jämtland, Brunflo.Ekendahl 2006	365	14,86138889	63,07388889	wood	FJ866810, MF114664	MF114909	MF115031
furfuracea	PRA - Palice10657 (162)	Sweden, Kvissle	295	13,91666667	63,26666667	wood of stump	MF114640	MF114894	
furfuracea	LD - Ekendahl (coll. 2006) (273)	Sweden. Jämtland, Krokom	355	13,96194444	63,36333333	wood	FJ866811, MF114666		MF115033
furfuracea	S - Wetmore 81336 (U579)	USA, Wyomming	2200	-110,0630556	44,97888889	stump	FJ866813, MF114815		
furfuracea	PRA - Palice 9511	Norway, Sør-Trøndelag, Oppdal, Kongsvoll	865	9,616666667	62,31666667	twigs of Juniperus communis	MF114708		
furfuracea	PRA - Vondrák 13059	Russia, S Ural Mts, Kuvandik	350	57,453889	51,669167	bark of Quercus robur	MF114716	MF114940	
furfuracea	ALTB - Davydov 10713_yellow thallus	Russia, Altaisky krai, Tigirek	1350	82,997222	51,039722	Betula bark	MF114733		MF115083
furfuracea	ALTB - Davydov 10713_grey thallus	Russia, Altaisky krai, Tigirek	1350	82,997222	51,039722	Betula bark	MF114734		MF115084
furfuracea	LE - Chesnokov 180	Russia, Trans-Baikal Krai, Kodar ridge, Sul'ban valley	1383	117,299056	56,844583	wood of Chosenia arbutifolia	MF114813		MF115138
Caloplaca fuscorufa	Toby Spribille 39387 (78)	USA, Alaska, Glacier Bay NP	918	-135,5573	58,4646	siliceous rock	MF114598	MF114860	MF115104
Caloplaca fuscorufa	PRA - Palice7251 (93)	Sweden, Abisko	400	18,89033333	68,44	mica-schist, below overhang	MF114599	MF114861	
Caloplaca fuscorufa	Irina Urbanovichene, s.n., 21.7.2005 (320)	Norway, Svalbard	NA	NA	NA	siliceous rock	MF114690		MF114994
Caloplaca fuscorufa	Ivan Frolov 1186	Russia, Murmansk region, Rybachy Peninsula	80	32,0864	69,878056	vertical surfaces of shale outcrops	KX022972		MF115126
Caloplaca fuscorufa	PRA - Vondrák 6204	Ukraine, Eastern Carpathians	1300	24,22277778	48,26138889	base-rich sandstone	KC416111		
Caloplaca fuscorufa	LD - Arup L03549	Sweden, Lycksele lappmark, Tärna, Rönäs	510	14,76678	65,84921	siliceous slate rock	EF643513		
gennargentuae	PRA - Vondrák 9609	Italy, Sardinia, Genargentu Mts	1450	9,283333333	40,06666667	granite rock	MF114665, MF114686,	MF114923	MF115051
herbidella	Irina Urbanovichene, s.n. (65)	Russia, Caucasus Mts, Laganaki	1550	40	44,06666667	Abies nordmanniana, twigs	MF114752	MF114965	MF115101
herbidella	GZU (Bilowitz 2008)	Bosnia and Herzegovina, Sutjeska national park	1120	18,7	43,3	Abies alba	MF114605	MF114866	MF114998
herbidella	ERC - Halıcı CL226	Turkey, Giresun, Kulakkaya plain, Bektaş forest	1740	38,58333333	40,56666667	Picea orientalis	MF114777	MF114973	MF115109
herbidella	Ivan Frolov 673 (264)	Abkhazia, Caucasus Mts, 26 km N of Bzypta	1600	40,6	43,5	trunk of Quercus sp.	MF114663	MF114908	MF115030

herbidella	PRA - Palice18601	Austria, Salzburg, Bucheben	1210	12,98638889	47,12472222	Alnus incana	MF114701	MF114936	MF115067
herbidella	Ivan Frolov 679	Abkhazia, Caucasus Mts, 30 km N of Bzypta	1200	40,51638889	43,47388889	trunk of Abies nordmanniana	MF114697		MF115062
herbidella	PRA - Palice16756	Slovakia, Muránska planina Mts	751	20,03694444	48,76166667	Quercus	MF114698		MF115063
herbidella	LD - Arup L06013	Sweden, Gotland, Fleringe, U746	25	18,87527778	57,85777778	Quercus robur	FJ866799		
herbidella	LD - Arup L07101	Sweden, Gotland, Bunge	25	18,99388889	57,85416667	Juniperus communis	FJ866800		
herbidella	LD - Arup L07102	Sweden, Gotland, Bunge	25	18,99388889	57,85416667	Juniperus communis	FJ866801		
herbidella	UPS - Thor 19503	Italy, Veneto, Belluno	1715	252,3791667	46,35416667	Sorbus aucuparia	FJ866802		
herbidella	UPS - Thor 19193	Italy, Trentino-Alto Adige, Trento	1500	11,73333333	46,3	Picea abies	FJ866803		
herbidella	E - Coppins & Khodosovtsev 17643	Ukraine, E Carpathians, Stuzhitsa	450	22,55	49,06666667	Carpinus betulus	FJ866804		
herbidella	GZU - Hafellner 63301	Austria, Steiermark, Kalkalpen, Hochschwab-Grupp	NA	15,26666667	47,61666667	Fagus silvatica	FJ866805		
herbidella	GZU - Hafellner 63640	Austria, Steiermark, Nördliche Kalkalpen, Hochschwab-gruppe, Schwabeltal	NA	14,85	47,61666667	Fraxinus excelsior	FJ866806		
herbidella	PRA - Vondrák 3968	Romania, Retzeat Mts, Lupeni, Câmpu liu Neag	1150	22,95	45,3	Fagus silvatica	FJ866807		
herbidella	ERC - Halıcı CL277	Turkey, Bolu, Abant, northeast of Örencik Village	1420	31,26666667	40,56666667	Abies nordmanniana	MF114779		
herbidella	PRA - Vondrák 15529	Russia, Caucasus Mts, Maykop, Guzeripl	1911	40,15161	43,92619	trunk, branches of Betula	MF114850		
herbidella	PRA - Vondrák 16090	Russia, Caucasus Mts, Maykop, Guzeripl	1724	40,1473	43,93632	trunk of Abies nordmanniana	MF114852		
herbidella	PRA - Vondrák 16092	Russia, Caucasus Mts, Maykop, Guzeripl	1724	40,1473	43,93632	snag	MF114851		
herbidella	PRA - Vondrák 15939	Russia, Caucasus Mts, Maykop, Guzeripl	1724	40,1473	43,93632	trunk of Abies nordmanniana	MF114853		
herbidella subsp. acidophila	PRA - Vondrák 11339, 13060 (62)	Russia, Southern Ural Mts	750	58,9	54,91666667	Picea obovata, twigs	MF114750	MF114963	MF115100
herbidella subsp. acidophila	PRA - Irina Urbanovichene, s.n. (JV17838)	Russia, Southern Ural, Zyuratkul	700	58,93333333	54,83333333	Picea obovata	MF114751	MF114964	MF115059
hungarica	Jiří Malíček 3943 (165)	Austria, Graz, Grazer Bergland	900	15,48333333	47,18333333	wooden fence	MF114642	MF114896	MF115019
hungarica	PRA - Vondrák 12579 (282)	Osmaniye, Zorkun	1560	36,36666667	36,98333333	twigs of Pinus nigra	MF114672	MF114913	MF115037
hungarica	Ivan Frolov 772	Serbia, Užice, Kremna	720	19,63333333	43,83333333	twigs of Pinus nigra	MF114695	MF114932	MF115060
hungarica	Ivan Frolov 961 (577)	France, Gorges Du Verdon	850	6,317	43,762944	twigs of Pinus silvestris	MF114740	MF114954	MF115089
hungarica	ERC - Halıcı CL866 (321)	Turkey, Isparta, Sütçüler, Aksu	1150	31,18111111	37,78861111	Pinus nigra	MF114795	MF114984, MF114985	MF115123
hungarica	PRA - Palice 8958 (122)	Slovakia, W Carpathians, Muráň	450	20,01666667	48,75	Juglans regia	MF114610	MF114869	
hungarica	GZU - Obermayer 9228 (113)	Austria, Schladming	1060	13,68333333	47,31666667	Alnus incana	MF114606		
hungarica	ERC - Halıcı CL155	Turkey, Sinop, Boyabat, Dranaz Pass	715	34,92388889	41,71138889	Quercus	MF114635		
hungarica	LD - Arup L05170	Sweden, Jämtland: Åre par., Handöl	670	12,44555556	63,24472222	Sorbus aucuparia	MF114834		
hungarica	LD - Arup L97206	Austria, Steiermark. Grazer Bergland, Hochlandtsch Mts, Teichalpe	1140	15,13333333	47,35	Wooden fence	MF114835		
hungarica	GZU - Obermayer 9101	Austria, Schladminger Tauern, Obertal	1060	13,68333333	47,31666667	Alnus incana	MF114822		

hungarica	PRA - Vondrák 14545	Russia, Dagestan, Gunib	1900	46,921263	42,414789	Betula twigs	MF114802		
hungarica	Ivan Frolov 1690	Greece, Mt Olympus	1980	22,373015	40,082056	on Pinus heldreichii	MF447218		
hungarica	GZU - Lucia Muggia 0325-13 (603)	Greece, Konitsa, Molista	1210	20,8173	40,120583	Pinus nigra bark		MF114961	MF115098
hungarica	ERC - Halıcı CL473	Turkey, Kütahya, Ilıca, west of Soğukçeşme Village	1070	30,05138889	39,595	Quercus		MF114977	MF115114
hungarica	PRA - Genadii Urbanavichus, s.n. (318)	Russia, Black Sea coast, Utrish state reserve	95	37,45	44,78333333	Juniperus twigs		MF114926	MF115054
hungarica	ERC - Halıcı CL520	Turkey, Karabük, Eflani, northwest of Karlı Village	1010	33,05888889	41,46444444	Juniperus		MF114979	MF115117
hungarica aff.	Javier Etayo 24477b	Chile, Region del Maule, Reserva N. Siete Tazas	750	-70,929448	-35,472039	epiphyte	MF114836		
lauri	PRA - Vondrák 12565 (290)	Great Britain, Scotland, Oban, Balvicar	40	-5,615277778	56,27	Quercus twigs	MF114677		MF115041
lauri	PRA - Vondrák 12566 (289)	Great Britain, Scotland, Oban, Balvicar	40	-5,615277778	56,27	Ulmus twigs	MF114676	MF114916	MF115040
lauri	PRA - Vondrák 12600 (219)	Spain, Canary Islands, Tenerife, Las Mercedes	940	-16,25805556	28,53138889	bark of Laurus	MF114647		
lauri	PRA - Vondrák 12095 (143)	Spain, Canary Islands, La Palma, San Isidro	1450	-17,83277778	28,61222222	bark of Laurus	MF114623	MF114881	MF115008
lauri	PRA - Vondrák 12108 (140)	Spain, Canary Islands, La Palma, Barlovento	1250	-17,83638889	28,80555556	bark of Castanea sativa	MF114620	MF114878	MF115005
lauri	PRA - Vondrák 12120 (154)	Spain, Canary Islands, La Palma, Barlovento, Los Sauces	1050	-17,81444444	28,785	twigs of Pinus canariensis	MF114634		MF115015
lauri	PRA - Vondrák 13104 (519)	Portugal, Madeira, Pico ruivo do Paul	1550	-17,083027	32,772501	Quercus	MF114730	MF114950	
lauri	Mark Powell 828 (221)	Great Britain, N.W. Scotland, Island of Raasay	100	-6,033333333	57,35	?	MF114648	MF114901	
lauri	LD - Arup U2540	Great Britain, Scotland, West Ross	5	-5,6892166	57,3235	Sorbus aucuparia	MF114858		
monticola	ERC - Halıcı CL506	Turkey, Çankırı, Ilgaz Mountain Natural Park	1835	33,75722222	41,06361111	wood Abies nordmanniana	MF114790	MF114978	MF115116
monticola	PRA - Vondrák 11337 (118)	Russia, S Ural	750	58,9	54,91666667	Picea obovata	MF114607	MF114867	MF114999
monticola	Ivan Frolov 671 (262)	Abkhazia, Caucasus Mts, NP Ritsinskiy	1990	40,69111111	43,48166667	wood of Juniperus cf. nana	MF114662	MF114907	MF115029
monticola	Genadii Urbanavichus ПАЗ 15-08 (F57 DNA)	Russia, Murmansk region, Pasvik Reserve	69	29,459895	69,289257	bark	MF114811	MF114992	MF115136
monticola	Genadii Urbanavichus ЛК 01 (F48 DNA)	Russia, Caucasus Mts, Caucasus reserve, Lagonaki plateau	1730	40,014192	44,061999	bark of Pinus	MF114805	MF114990	MF115131
monticola	Genadii Urbanavichus ЛК 01 (F60 DNA)	Russia, Caucasus Mts, Caucasus reserve, Lagonaki plateau	1730	40,014895	44,062221	bark of Pinus	MF114812, MF114814		MF115139
monticola	ERC - Halıcı CL48	Turkey, Antalya, Alanya, Gevne Valley	1175	32,44666667	36,68305556	wood Pinus nigra	MF114789		MF115115
monticola	Jiří Malíček 4254 (128)	Albania, Shkodër, Valbona Mts	1850	19,78333333	42,45	Pinus heldreichii	MF114613	MF114872	
monticola	GZU - Obermayer 9178 (111)	Austria, Schladming	2020	13,61666667	47,26666667	Rhododendron hirsutum over calc. subst.	MF114604	MF114865	
monticola	Jiří Malíček 4280 (ITS: 155)	Albania, Theth, NP Theth	1950	19,78333333	42,41666667	Pinus wood	MF114636	MF114891	
monticola	ALTB - Davydov 11222	Russia, Altai Mts	1330	83,01138889	51,09527778	Betula pendula		MF114931	
monticola	LD - Arup L07100	Sweden, Härjedalen: Tännäs, Ramundberget	830	12,39222222	62,69138889	Sorbus aucuparia	FJ866809		
monticola	PRA - Palice12390	Austria, Carinthia, Gurktaler Alpen	1890	13,73333333	46,86666667	wooden stump of Pinus cembra	KC416120		
monticola	Ivan Frolov 499	Russia, S Ural, Bashkir natural reserve	750	57,06666667	53,33333333	twigs of Juniperus sibirica	MF114766		

monticola	GZU - Hafellner 70259 (TS1254)	Austria, Styria, Koralpe, Moschkogel	1760	14,98333333	46,8	Rhododendron ferrugineum	MF114824		
monticola	GZU - Hafellner 76950 (TS1251)	Italy, Karnishe Alps, Ampezzo	1750	12,78333333	46,41666667	twigs of Larix decidua	MF114823		
monticola	PRA - Vondrák 12585 (252)	Turkey, Mersin, Anamon, Abaqnoz Yaylasi	1760	32,8	36,35	bark of Cedrus libanii	MF114656		
monticola	PRA - Vondrák 12587 (251)	Turkey, Mersin, Anamon, Abaqnoz Yaylasi	1760	32,8	36,35	wood of living Cedrus libanii	MF114655		
monticola	Ivan Frolov 667 (257)	Abkhazia, Caucasus Mts, NP Ritsinskiy	2100	40,6	43,51166667	wood of Juniperus cf. nana	MF114658		
monticola	Ivan Frolov 1189	Russia, Murmansk region, Rybachy Peninsula	24	32,066165	69,7836	wood of Populus tremula	MF114694		
monticola	Ivan Frolov 1648	Greece, Konitsa, Mt Smolikas	1900	20,906426	40,057701	on Pinus heldreichii	MF447222		
monticola	Ivan Frolov 1608	Albania, NP Llogara	1700	19,591447	40,198702	on trunk of Pinus heldreichii	MF447219		
palmae	PRA - Vondrák 12572 (284)	Portugal, Lisbon, Malveira da Serra, Biscaia	50	-9,476111111	38,75388889	twigs of Rosmarinum	MF114674	MF114914	MF115038
palmae	PRA - Vondrák 12605 (222)	Spain, Canary Islands, Tenerife, Vilaflor	1250	-16,65333333	28,14305556	bark of Amygdalus	MF114649	MF114902	MF115024
palmae	PRA - Vondrák 12098 (147)	Spain, Canary Islands, La Palma, Santa Cruz de La Palma, San Isidro	650	-17,80027778	28,63027778	bark of Ficus carica	MF114627	MF114884	MF115010
palmae	PRA - Vondrák 12102 (139)	Spain, Canary Islands, La Palma, El Passo, Las Manchas	500	-17,88972222	28,60361111	bark of Euphorbiaceae shrub	MF114619	MF114877	MF115004
palmae	PRA - Vondrák 12104 (149)	Spain, Canary Islands, La Palma, El Passo, Las Manchas	1200	-17,85722222	28,60833333	twigs of Pinus canariensis	MF114629	MF114886	MF115012
palmae	PRA - Vondrák 12106 (152)	Spain, Canary Islands, La Palma, El Passo, Las Manchas	1000	-17,85722222	28,60833333	twigs of Pinus canariensis	MF114632	MF114889	MF115014
palmae	Ivan Frolov 1007 (582)	Spain, Andalusia, Cádiz, NP Barbate	30	-5,997917	36,182417	Juniperus phoenicea	MF114744	MF114956	MF115092
palmae	PRA - Vondrák 13102 (514)	Portugal, Madeira, Ponta do Pargo	200	-17,249187	32,803004	Euphorbia in coastal bush	MF114726	MF114948	MF115080
palmae	PRA - Vondrák 12101 (135)	Spain, Canary Islands, La Palma, Barlovento	1250	-17,83638889	28,80555556	bark of Castanea sativa	MF114616	MF114875	
palmae	PRA - Vondrák 13108	Portugal, Madeira, Eira do Serrado	1000	-16,963002	32,711423	twigs of Castanea sativa	MF114729		
palmae	PRA - Vondrák 12574	Portugal, Lisbon, Sesimbra	40	-8,968888889	38,48444444	bark of Olea oleaster	MF114673		
palmae	J. Klepsand (JK14-1313, pers. herb.)	Spain, Canary Islands, Tenerife, Anaga	190	-16,175295	28,578785	Euphorbia balsamifera	MF447189		
palmae	J. Klepsand (JK14-1220, pers. herb.)	Spain, Canary Islands, Tenerife, Anaga	255	-16,159477	28,568231	Euphorbia balsamifera	MF447190		
palmae	PRA - Vondrák 17868	Spain, Andalusia, Tarifa	380	-5,72288	36,08557	twigs of Olea europaea	MF447198		
palmae	PRA - Vondrák 17885	Spain, Andalusia, Tarifa	380	-5,72288	36,08557	bark of Olea europaea	MF447201		
Caloplaca phaeocarpella	C - Søchting (Dupl. PRA - Vondrák 7662)	Svalbard	20	NA	NA	driftwood	MF114596		MF114993
psychrophila	ERC - Halıcı CL355	Turkey, Bursa, Uludağ, Hotel area	1960	29,1275	40,1	siliceous rock	MF114784	MF114976	MF115112
psychrophila	ERC - Halıcı CL678	Turkey, Afyon, Sandıklı, Çakmaktepe Pass	1900	30,38805556	38,47361111	siliceous rock	MF114791	MF114981	MF115119
psychrophila	PRA - Vondrák 11852	Poland, Krkonoše Mts, Mały Kocioł Snieżny	1400	15,55	50,76666667	bazalt rock in subalpine zone	MF114614	MF114873	
psychrophila	Ivan Frolov 766	Serbia, Stara Planina Mts, Kalna	1600	22,6	43,36666667	vertical side of base-rich siliceous rock, in subalpine belt	MF114807		MF115132
psychrophila	GZU (Mayrhofer & Atanassova 2010) (57)	Bulgaria, Rila Mts, Sapareva banya	1982	23,31666667	42,21666667	amphibolite in alpine zone	MF114741		
psychrophila	PRA - Vondrák 6198	Ukraine, E Carpathians, Svidovets Mts	1300	24,21666667	48,25	sandstone in subalpine zone	KC416121		

psychrophila	PRA - Vondrák 6199	Ukraine, E Carpathians, Svidovets Mts	1300	24,21666667	48,25	sandstone in subalpine zone	KC416123		
psychrophila	ERC - Halıcı CL338	Turkey, Ankara, Güdül, South of Sorgun Municipality	1500	32,26194444	40,31027778	siliceous rock	MF114782		
psychrophila	ERC - Halıcı CL992	Turkey, Kars, Sarıkamış	2180	42,73194444	40,44861111	siliceous rock	MF114797		
psychrophila	C - Søchting 12142	Italy, Alps, Piemonte	1700	7,7	44,1	alpine siliceous rock	MF114843		
psychrophila	GZU328187 (coll. Mayrhofer & Kobald 2016)	Kosovo, Šar Planina Mts, Dragaš	2542	20,751397	41,898297	on base-rich schist in alpine zone	MF447223		
purpurea	PRA - Vondrák 12603 (217)	Spain, Canary Islands, La Palma, Barlovento	1000	-17,83638889	28,80555556	volcanic outcrop in forest	MF114645	MF114899	MF115022
purpurea	PRA - Vondrák 12123 (142)	Spain, Canary Islands, La Palma, Santa Cruz de La Palma, San Isidro	1050	-17,81777778	28,64472222	artificial volcanic outcrop in road cutting	MF114622	MF114880	MF115007
purpurea	PRA - Vondrák 13110 (507)	Portugal, Madeira, Curral das Freiras	650	-16,968415	32,713524	inland volcanic rock	MF114718	MF114941	MF115074
purpurea	PRA - Vondrák 13101 (509)	Portugal, Madeira, Pico do Gato	1700	-16,933149	32,739043	alpine volcanic rock	MF114720	MF114943	MF115076
relicta	Ulrika Nordin FU7663	Sweden, Östergötland	55	15,11	58,11	Fraxinus	MF114667	MF114911	MF115034
relicta	PRA - Palice 10549 (123)	Norway, Melhus	50	10,3	63,15	Salix caprea	MF114611, MF114685	MF114870	
relicta	LD - Arup U654, UA04452	Sweden, Uppland: Älvkarleby par., Björkön	40	17,31111111	60,46444444	Populus tremula	FJ866808		
relicta	C - Søchting 9996	Spain, Guadalaja, Torremocha	1100	-2,084333333	40,94216667	Quercus	KC179416		
relicta	C - Søchting 7308	Spain, Lugo	600	-7,316666667	42,88333333	Populus	MF114669		
relicta	MA - Lichen15458 (coll. S.Pérez-Ortega) DNA:S1	Spain, La Rioja, Villoslada de Cameros	1260	-2,7	42,1	Fagus sylvatica	MF447184		
relicta	PRA - Vondrák 17855	Spain, Castilla y León, Caboalles de Abajo	1280	-6,38336	42,96901	trunk of Acer pseudoplatanus	MF447196		
relicta	PRA - Vondrák 17874	Spain, Castilla y León, Portela, Trabadelo	650	-6,87929	42,6439	smooth bark of Juglans regia	MF447199		
relicta	PRA - Vondrák 17886	Spain, Castilla y León, Caboalles de Abajo	1280	-6,38336	42,96901	rough bark of Populus cf. nigra	MF447202		
relicta	PRA - Vondrák 17891	Spain, Castilla y León, Tiedra, Villardefrades	900	-5,21814	41,69291	trunk of Quercus ilex	MF447203		
remota	GZU - Obermayer 9054 (100)	China, Sichuan, Kangding	3200	101,9666667	29,56666667	Rhododendron twigs	MF114600	MF114862	MF114995
scabrosa	PRA - Vondrák 13628 (600)	Czech Republic, Hrubý Jeseník Mts, Velká kotlina	1250	17,236347	50,055828	schist rock in subalpine zone	MF114748	MF114959	MF115096
scabrosa	Ivan Frolov 685 (302)	Abkhazia, Caucasus Mts, NP Ritsinskiy	2050	40,69166667	43,46472222	big base rich siliceous stone, under overhang	KX022973	MF114922	MF115050
scabrosa	PRA - Vondrák 1907-1909 (301)	Czech Republic, Hrubý Jeseník Mts, Velká kotlina	1250	17,23333333	50,05	base-rich phyllite	KC416122		MF115049
scabrosa	Ivan Frolov 1187	Russia, Murmansk Region, Rybachy Peninsula	100	69,78333	32,066667	shale outcrops, in deep crevice	KX022974		MF115125
scabrosa	PRA - Vondrák 9402	Svalbard, isotype	100	15,86944444	77,99444444	sandstone rock	KX022975		
scabrosa	PRA - Vondrák 17850	Spain, Granada, Siera Nevada	2500	-3,38743	37,09724	mica schist, below overhang	MF447194		
scabrosa (aff.)	Westberg 28 June 2013, U2515	Norway, Oppland, Lom, Bøverdalen	730	8,02618	61,72367		MF447191		
sp.	Josef Halda 0968	Madagaskar, central part, Mt Itremo, Atofinandrahana	1800	-20,49999	46,5	plant debris	MF114806		
subathalilina	LD - Arup L13265	Sweden, Gotland, Hejnum	70	18,64449	57,69528	Prunus spinosa	MF114859		
subathallina	PRA - Vondrák 12096 (137)	Spain, Canary Islands, La Palma, El Passo, Las Manchas	1200	-17,85722222	28,60833333	bark of Castanea sativa	MF114618	MF114876	MF115003

subathallina	PRA - Vondrák 12103 (148)	Spain, Canary Islands, La Palma, El Passo, Las Manchas	1200	-17,85722222	28,60833333	twigs of Pinus canariensis	MF114628	MF114885	MF115011
subathallina	Jiří Malíček 7422	Italy, Aeolian Islands, Salina Island	400	14,85	38,56666667	Alnus sp.	MF114684	MF114921	MF115048
subathallina	PRA - Vondrák 12105 (153)	Spain, Canary Islands, La Palma, El Passo, Las Manchas	1000	-17,85722222	28,60833333	twigs of Pinus canariensis	MF114633	MF114890	
subathallina	PRA - Vondrák 11856 (91)	Greece, Peloponnese, Menalo Mts	1200	22,26666667	37,61666667	Abies cephalonica twigs	MF114761	MF114971	
subathallina	PRA - Vondrák 13107 (517)	Portugal, Madeira, Eira do Serrado	1000	-16,963002	32,711423	Castanea sativa	MF114728		MF115082
subathallina	PRA - Vondrák 12100 (136)	Spain, Canary Islands, La Palma, Barlovento	1250	-17,83638889	28,80555556	bark of Castanea sativa	MF114617		MF115002
subathallina	ERC - Halıcı CL1969 (487)	Turkey, Kastamonu, Küre	970	33,718972	41,88025	twigs of Abies mordmanniana	MF114713		
subathallina	PRA - Vondrák 12109 (146)	Spain, La Palma, Santa Cruz de La Palma, San Isidro	1450	-17,83833333	28,61388889	twigs of Pinus canariensis	MF114626		
subathallina	PRA - Vondrák 6605 (95)	Turkey, Esenköy	20	28,88333333	40,58333333	Fraxinus	MF114762		
subathallina	LD - Arup L09034	Sweden, Gotland, Ölbäck	75	18,37444444	57,62166667	Juniperus communis	MF114828		
subathallina	LD - Arup L07105	Sweden, Gotland: Bunge par., W of Stenstugu	25	18,99388889	57,85416667	Juniperus communis	MF114826		
subathallina	UPS - Thor 19997h	Sweden. Bohuslän, Strömstad	5	11,04583333	58,88972222	Fraxinus excelsior	MF114829		
subathallina	LD - Arup L11032	Sweden, Närke, Harge Uddar	90	14,93138889	58,77388889	Pinus silvestris	MF114830		
subathallina	LD - 2012-06-19 S. Svensson	Greece, Lesbos, Lasfionas	300	26,17444444	39,30361111	Vitex agnus-castus	MF114832		
subathallina	PRA - Genadii Urbanavichus (s.n.)	Russia, Black Sea coast, Utrish state reserve	96	37,45	44,78333333	Juniperus twigs	MF114689		
subathallina	Ivan Frolov 952 (484)	Italy, Sardinia, Olbia, San Pantaleo	100	9,446111	41,0355556	Mediterranean shrubs	MF114712		
subathallina	Claude Roux 26712	France, Provence, Mirabeau	550	5,64794	43,68864	Pistacia terebinthus	MF114710		
subathallina	PRA - Vondrák 17849	Spain, Castilla y León, Toreno	740	-6,49953	42,67279	twigs of Quercus ilex	MF447193		
xerothermica	PRA - Vondrák 8863	Greece, Peloponnese, Epidavros	400	23,18333333	37,55	Pistacia lentiscus	MF114609	MF114868	MF115000
xerothermica	PRA - Vondrák 8616	Greece, Peloponnese, Epidavros	400	23,18333333	37,55	Pistacia lentiscus	MF114612	MF114871	MF115001
xerothermica	Jiří Malíček 4211 (ITS: 161)	Albania, Korcë, NP Drenove	1400	20,83333333	40,58333333	Abies alba	MF114639	MF114893	MF115018
xerothermica	Jiří Malíček 4157 (ITS: 167)	Albania, Burrel, Lis	540	20,08333333	41,63333333	Malus domestica	MF114644	MF114898	MF115021
xerothermica	PRA - Vondrák 8822 (89)	Greece, Kalampaka	450	21,61666667	39,7	shrub bark	MF114760	MF114970	MF115106
xerothermica	Ivan Frolov 1033 (581)	France, Gorges Du Verdon	850	6,317	43,762944	twigs of Pinus halepensis	MF114743	MF114955	MF115091
xerothermica	ERC - Halıcı CL740	Turkey,Bilecik, Yenipazar, Kümbet Village	675	30,38138889	40,22111111	Pistacia twigs	MF114792		MF115120
xerothermica	Jiří Malíček 7424 (299)	Italy, Sicily, Madonie NP	820	13,98333333	37,9	Pyrus amygdaliformis	MF114683		MF115047
xerothermica	Ivan Frolov 973 (583)	France, Gorges Du Verdon	850	6,317	43,762944	Pistacia terebinthus	MF114745		MF115093
xerothermica	Ivan Frolov 974 (580)	Spain, Andalusia, NP Grazalema	1280	-5,386472	36,738528	Pinus pinaster	MF114742		MF115090
xerothermica	C - Søchting 9665, KC179417, CBFS	Spain, Granada	1200	-3,483333333	37,23333333	Pinus twigs	KC179417		
xerothermica	ERC - Halıcı CL414	Turkey, Bilecik, Söğüt	560	30,2375	40,02694444	Pistacia	MF114786		

xerothermica	ERC - Halıcı CL455	Turkey, Muğla	580	28,36111111	37,06805556	Daphne	MF114788		
xerothermica	C - Søchting 10523_1438	Spain, Madrid, El Pardo	650	-3,776111111	40,52055556	Pinus pinea twigs	MF114838		
xerothermica	S - Westberg 10-204	Spain, Madrid, Aranjuez, Finca Sotomayor	540	3,553611111	40,03694444	shrubs	MF114833		
xerothermica	LD - 2012-06-19 S. Svensson	Greece, Lesbos, Lasfionas	300	26,17444444	39,30361111	Vitex agnus-castus	MF114831		
xerothermica	ERC - Halıcı CL1765	Turkey, Muğla	55	28,60861111	36,94166667	Quercus twigs	MF114772		
xerothermica	ERC - Halıcı CL1681	Turkey, Sakarya	400	30,20638889	40,5425	Quercus coccifera twigs	MF114771		
xerothermica	PRA - Vondrák 12752, Ivan Frolov928	France, Maritime Alps	880	7,588888889	44,09861111	young Fraxinus	MF114700		
xerothermica	PRA - Vondrák 17867	Spain, Madrid, Tablada	1530	-4,14233	40,70266	twig of Sarothamnus scoparius	MF447197		
xerothermica	PRA - Vondrák 17879	Spain, Ronda, Sierra de las Nieves	1550	-5,03001	36,69181	twig of Pinus sylvestris	MF447200		
xerothermica	PRA - Vondrák 17901	Spain, Castilla y León, Tiedra, Villardefrades	900	-5,21814	41,69291	trunk of Quercus ilex	MF447205		
xerothermica	PRA - Vondrák 17906	Spain, Ronda, Sierra de las Nieves	1700	-5,02427	36,68848	trunk of Pinus pinaster	MF447207		
xerothermica	PRA - Vondrák 17907	Spain, Ronda, Sierra de las Nieves	1740	-5,02158	36,68914	twigs of Quercus faginea	MF447208		
xerothermica	GZU 330190 (coll. Mayrhofer 2016)	Croatia, Primorsko-Goranska, Učka	817	14,228929	45,318927	thick branch of Prunus	MF447209		
xerothermica	ERC - Halıcı CL579	Turkey, Manisa, Gördes, Dağdere Village	800	28,08194444	39,00083333	Pinus brutia		MF114980	MF115118
xerothermica	ERC - Halıcı CL965	Turkey, Asparta	1030	30,88333333	37,56666667	Juniperus twigs		MF114986	MF115124
xerothermica	C - Søchting (in sample 9995 with B. ferruginea)	Spain, Guadalajara, Selas	1230	-2,083333333	40,93333333	Quercus		MF114935	MF115066
xerothermica	ERC - Halıcı CL751	Turkey, Bilecik, Yenipazar	875	30,57972222	40,21472222	Quercus		MF114982	MF115121
xerothermica subsp. macaronesica	PRA - Vondrák 13103 (510)	Portugal, Madeira, Pico do Gato	1750	-16,933149	32,739043	dead twigs of Sarothamnus	MF114722	MF114945	MF115077
xerothermica subsp. macaronesica	PRA - Vondrák 12753	Spain, Canary Islands, La Palma, Barlovento, above road to Roque Faro	1750	-17,85111111	28,77138889	twigs of Pinus canariensis	MF114646	MF114900	MF115023
xerothermica subsp. macaronesica	PRA - Vondrák 12099	Spain, Canary Islands, La Palma, Barlovento, above road to Roque Faro	2100	-17,85111111	28,77138889	wood of Pinus canariensis snag	MF114624	MF114882	MF115009
xerothermica subsp. macaronesica	PRA - Vondrák 12111	Spain, Canary Islands, La Palma, Barlovento, above road to Roque Faro	2100	-17,85111111	28,77138889	bark of Pinus canariensis	MF114625	MF114883	
xerothermica subsp. macaronesica	PRA - Vondrák 12607	Spain, Canary Islands, Tenerife, Corona forestal	2200	-16,48694444	28,3375	alpine shrub		MF114903	MF115025
ammiospila	Alexander Paukov AGP20080802-15	Russia, Bashkirtostan, Abzelilovsk	890	58,58333333	53,7	plant debris			
ammiospila	C - Søchting 5430	Norway, Dovre	1000	9,587113889	62,13383333	Salix			
ammiospila	C - Søchting 4804	Norway, Porsanger	300	26,45	70,3	Juniperus			
ammiospila	C - Søchting 5347	Norway, Oppland, Dovre	1100	9,516666667	62,03333333	Salix shrub twigs			
ammiospila	C - Søchting 5280	Norway, Oppland, Vang	1200	9,5	62,51666667	Salix shrub twigs			
ammiospila	C - Søchting 5187	Norway, Båtsfjord, Hamnefjell	50	29,7	70,65	Salix shrub twigs			
ammiospila	C - Søchting 5417	Norway, Oppland, Vågå	800	13,28333333	66,7	Populus tremula			
ammiospila	C - Søchting 5393	Norway, Oppdal	1200	9,683333333	62,58333333	Salix shrub twigs			

ammiospila	C - Søchting 12099	Italy, Piemonte	1702	7,8	44,1	mosses
ammiospila	C - Søchting 5432	Norway, Oppland, Dovre	1000	9,516666667	62,03333333	Salix shrub twigs
ammiospila	C - Søchting 5304	Norway, Oppland, Dovre	960	9,516666667	62,03333333	Populus tremula
ammiospila	C - Søchting 5214	Norway, Oppland, Tretten	950	10,08333333	61,33333333	Salix shrub twigs
ammiospila	C - Søchting 5006	Norway, Finnmark, Veines	10	24,98333333	70,01666667	Salix shrub twigs
ammiospila	C - Søchting 4684	Norway, Nordreisa, Reisadalen	490	21,1	69,73333333	Picea obovata twig
ammiospila	C - Søchting 4880	Norway, Vaggatem	60	29,26666667	69,26666667	Populus tremula
ammiospila	C - Søchting 4663a	Norway, Nordreisa, Reisadalen	490	21,1	69,73333333	Salix shrub twigs
ammiospila	C - Søchting 5343	Norway, Oppland, Dovre	1100	9,516666667	62,03333333	Salix shrub twigs
ammiospila	C - Søchting 4662b	Norway, Nordreisa, Reisadalen	440	21,1	69,73333333	Salix shrub twigs
ammiospila	C - Søchting 5278	Norway, Oppland, Vang	1210	9,5	62,51666667	Salix shrub twigs
ammiospila	C - Søchting 5433, C - Søchting 5430	Norway, Oppland, Dovre	1050	9,516666667	62,03333333	Salix shrub twigs
ammiospila	C - Søchting 5338	Norway, Oppland, Dovre	1100	9,516666667	62,03333333	Salix shrub twigs, calcareous soil
ammiospila	C - Balschmidt 15004, 15090, 14984	Svalbard	10	18,66666667	78,66666667	drift wood
ammiospila	C - Søchting 5023a	Norway, Finnmark, Storfjellet	100	23,86666667	70,68333333	Salix shrub twigs
ammiospila	C - Søchting 5346	Norway, Oppland, Dovre	1100	9,516666667	62,03333333	Juniperus
ammiospila	C - Søchting 4661	Norway, Nordreisa, Reisadalen	440	21,1	69,73333333	Salix shrub twigs, with C. borealis
ammiospila	C - Søchting 5413	Norway, Oppland, Vågå	1000	13,28333333	66,7	Salix shrub twigs
ammiospila	C - Søchting 4841b	Norway, Finnmark, Adamsfjord	?	27,38333333	70,23333333	Salix shrub twigs
ammiospila	C - Søchting 5136b	Norway, Finnmark, Båtsfjord	110	29,63333333	70,56666667	Sorbus
ammiospila	C - Søchting 5429	Norway, Oppland, Vågå	900	13,28333333	66,7	Juniperus
ammiospila	C - Søchting 5410	Norway, Sør-Trøndelag	1100	10,33333333	63	Betula nana
ammiospila	C - Søchting 5369	Norway, Sør-Trøndelag	1200	10,33333333	63	Salix shrub twigs
ammiospila	C - Søchting 4788	Norway, Finnmark, Porsanger	10	25,3	70,38333333	Salix shrub twigs
ammiospila	C - Søchting 9345	Austria, Steiermark, Koralpe	1750	15,01833333	46,84166667	Detritus
ammiospila	Irina Urbanovichene, s.n., 31.05.2009	Russia, S Ural, Zyuratkul	1247	58,93333333	54,83333333	twigs of Picea abies in subalpine zone
ammiospila	PRA - Vondrák 3820	Austria, Schladming	2100	13,81666667	47,33333333	plant debris
ammiospila	PRA - Vondrák 3602	Romania, Retezat Mts, Mt Peleaga	2350	22,88333333	45,35	plant debris
ammiospila	PRA - Vondrák 11336	Russia, S Ural, Mt Bolshoy Shalom	1200	58,31666667	54,68333333	Juniperus sibirica twigs
ammiospila	GZU (Mikulin 1984)	Russia, Kamchatka	370	158,1166667	54,81666667	Populus

ammiospila	PRA - Vězda 16260	Slovakia, Velká Fatra Mts, Mt Tlstá	1400	19,1	48,93333333	plant debris
ammiospila	PRA - Vězda: Lich. Sel. Exs. 48	Slovakia, Belanské Tatry Mts, Mt Jatky	2000	20,23333333	49,23333333	plant debris
ammiospila	PRA - Vězda 16280	Slovakia, Malá Fatra Mts, Mt Chléb	1600	19,05	49,18333333	alpine mosses and dead plants
ammiospila	PRA - Vězda 16254	Slovakia, Liptovské hole Mts, Ráčková plesa	1800	19,73333333	49,18333333	mosses over granite
ammiospila	PRA - Vězda 16950	Armenia, Krasnoselsk	2100	45,28333333	40,53333333	plant debris
ammiospila	PRA - Räsänen: Lich. Fen. Exs. 437	Finland, Karelia ladogensis, Kurkijoki, Lapinlahti	150	27,21666667	63,23333333	mosses
ammiospila	PRA - Vězda 16238	Slovakia, Nízké Tatry Mts, Mt Králíčky	1900	19,51666667	48,93333333	mosses
ammiospila	PRA - Vězda 24449	Slovakia, Belanské Tatry Mts, Mt Bujačí	1900	20,23333333	49,23333333	mosses and plant debris
ammiospila	PRA - Palice17485	Slovakia, Belanské Tatry Mts, Vysoké kopské sedlo	1930	20,23333333	49,23333333	plant debris
ammiospila	PRA - Vězda 16256	Slovakia, Nízké Tetry Mts, Kozí chrbty	1700	19,51666667	48,93333333	mosses
ammiospila	PRA - Vězda 15432, 15433	Czech Republic, Hrubý jeseník Mts, Petrovy kameny	1440	17,23333333	50,06666667	mosses
ammiospila	PRA - Vězda 16252	Slovakia, Liptovské hole Mts, Mt Baranec	2000	19,73333333	49,18333333	plant debris
ammiospila	PRA - Vězda 16257	Slovakia, Nízké Tatry Mts, Krakova hola	1700	19,51666667	48,93333333	mosses
ammiospila	PRA - Vězda 20663	Russia, Caucasus Mts, Mt Elbrus	3050	42,35	43,31666667	mosses
ammiospila	PRA-V-15427	Slovakia, Vysoké Tatry Mts, Velická dolina	1850	20,11666667	49,16666667	mosses
ammiospila	PRA - Vězda 16250	Slovakia, Malá Fatra Mts, Mt Velký Rozsutec	1600	19,08333333	49,21666667	mosses and plant debris
ammiospila	PRA - Vězda 15429	Slovakia, Vysoké Tatry Mts, Východní Batizovské sedlo saddle	2200	20,11666667	49,16666667	mosses and plant debris
ammiospila	PRA - Vězda 9591	Austria, Tirolia, Stubaier Alpen, Kirchdach	2420	11,35	47,03333333	mosses
ammiospila	Josef Halda 828	Austria, Styria, Stubalpe, Köflach	1650	14,93333333	47,08333333	plant debris
ammiospila	Ivan Frolov 672	Abkhazia, Caucasus Mts, hospital Auadkhara	2100	40,6	43,51166667	mosses base rich siliceous outcrops
ammiospila	Josef Halda 5053	Russia, Caucasus Mts, Dombay	3200	41,71666667	43,25	dead parts of Saxifraga
ammiospila	Genadii Urbanavichus, s.n. (coll. 5.7.2012)	Russia, Caucasus Mts, Caucasus reserve, Lagonaki plateau	2460	39,892	44,064	plant debris
ammiospila	Ivan Frolov 767	Serbia, Stara Planina Mts, Kalna	1600	22,6	43,36666667	bryophytes
ammiospila	Ivan Frolov 769	Serbia, NP "Kopaonik"	1740	20,83333333	43,31666667	plant debris
ammiospila	PRA - Palice 18655	Austria, Salzburg, Goldberggruppe	2770	12,96666667	47,04972222	plant debris and bryophytes over granite
ammiospila	ALTB - Davydov, s.n. (coll. 18.7.2000)	Russia, Altai Mts	2400	85,983333	49,8	bryophytes
ammiospila	ALTB - Davydov, s.n. (coll. 19.7.2000)	Russia, Altai Mts	2300	86,016667	49,8	bryophytes
ammiospila	ALTB - s.n.	Kazakhstan, Altai Mts	2200	86,016667	49,116667	bryophytes
ammiospila	PRA - Vondrák 13163	Russia, S Ural Mts, Mt Bolshoy Shelom	1150	58,31	54,513056	wood of Juniperus sibirica twig
ammiospila	PRA - Vondrák 15098	Switzerland, Alps	1936	8,36847	46,47782	moss

ammiospila	PRA - Vondrák 15121	Switzerland, Alps	2019	8,4254	46,47315	Rhododendron ferrugineum
ammiospila	PRA - Vondrák 12419	China, Tian-Shan Mts, Urumchi, Tianshan Grand Canyon	3000	87,420897	43,28861	grass tufts
ammiospila	LE - Chesnokov s.n. (2014)	Russia, Trans-Baikal Krai, Kodar ridge	2053	117,583171	56,899459	mosses
ammiospila	LE - Chesnokov s.n. (2013)	Russia, Trans-Baikal Krai, Kodar ridge	1840	117,708958	56,909509	plant debris
ammiospila	LE - Chesnokov s.n. (2013)	Russia, Trans-Baikal Krai, Kodar ridge	1641	117,621659	56,935833	plant debris
ammiospila	LE - Chesnokov s.n. (2014)	Russia, Trans-Baikal Krai, Kodar ridge	1686	117,615607	56,940887	alpine shrubs (Salix)
ammiospila	LE - Chesnokov s.n. (2015)	Russia, Trans-Baikal Krai, Kodar ridge	1686	117,288664	56,83649	mosses
ammiospila	LE - Chesnokov s.n. (2015)	Russia, Trans-Baikal Krai, Kodar ridge	1975	117,413885	56,808151	mosses
ammiospila	LE - Chesnokov s.n.	Russia, Yamal	50	70,621668	68,464453	plant debris
ammiospila	LE - Chesnokov s.n.	Russia, Yamal	60	70,691448	68,486676	arctic shrub (Betula nana)
ammiospila	LE - Chesnokov s.n.	Russia, Yamal	67	70,66547	68,487436	plant debris
ammiospila	LE - Chesnokov s.n. (2016)	Russia, Yakutia, Tomponsky district	1029	139,247989	63,128956	mosses
ammiospila	LE - Chesnokov s.n. (2016)	Russia, Yakutia, Tomponsky district	1537	143,270948	64,492545	plant debris
anatolica	ERC - Halıcı CL 1,042	Turkey, Kayseri, Yahyalı, Aladağlar National Park, Hacer Forests	1800	35,48277778	37,93916667	wood Pinus nigra
caucasica	Ivan Frolov 677	Abkhazia, Caucasus Mts, NP Ritsinskiy	2050	40,58055556	43,52333333	base rich siliceous outcrops
caucasica	Ivan Frolov 678	Abkhazia, Caucasus Mts, NP Ritsinskiy	2050	40,69166667	43,46472222	vertical surface and under overhangs of big base rich
caucasica	Ivan Frolov 682	Abkhazia, Caucasus Mts, NP Ritsinskiy	2100	40,6	43,51166667	base rich siliceous outcrops
caucasica	Ivan Frolov 683	Abkhazia, Caucasus Mts, NP Ritsinskiy	2050	40,69166667	43,46472222	vertical surface and under overhangs of big base rich
coralliza	PRA - Vondrák 12107 (138)	Spain, Canary Islands, La Palma, Barlovento	1250	-17,83638889	28,80555556	Castanea sativa
coralliza	ERC - Halıcı CL1529	Turkey, Antalya, Alanya	1385	32,33333333	36,55	Abies cilicica
coralliza	MA - Lichen9295 (coll. Aragón et al.)	Spain, Albacete, Sierra de Alcaraz	1370	-2,4	38,7	Juniperus oxicedrus
coralliza	MA - Lichen9296 (coll. Aragón et al.)	Spain, Albacete, Sierra de Alcaraz	1580	-2,4	38,7	trunk of Pinus nigra
coralliza	MA - Lichen9297 (coll. Aragón et al.)	Spain, Albacete, Molinicos	1330	-2,2	38,5	trunk of Pinus nigra
coralliza	MA - Lichen5697 (coll. Etayo et al.)	Spain, Malaga, Ronda	1450	-5,2	36,7	trunk of Abies pinsapo
coralliza	MA - Lichen5541 (coll. Etayo)	Spain, Navarra, valle del Araquil	600	-1,9	42,9	trunk of Quercus pyrenaica
coralliza	MA - Lichen5521 (coll. Etayo)	Spain, Navarra, Oroquieta	750	-1,8	43,01	trunk of Quercus robur
coralliza	MA - Lichen3735 (coll. Etayo)	Spain, Navarra, Alcoz	560	-1,8	43	trunk of Quercus robur
coralliza	MA - Lichen5177 (coll. Sarrión)	Spain, Cuidad Real, Fuencaliente	1150	-4,3	38,4	Arbutus unedo
coralliza	MA - Lichen6915 (coll. Aragón & Herrero)	Spain, Soria, Torremocha de Ayllón	1000	-3,2	41,4	Juniperus thurifera
coralliza	MA - Lichen7458 (coll. Aragón & Martínez)	Spain, Jean, Sierra de Segura	1500	-2,7	38,3	Juniperus oxicedrus

coralliza	MA - Lichen7217 (coll. Aragón & Martínez)	Spain, Toledo, Los Navalucillos	920	-4,7	39,7	trunk of Quercus rotundifolia
coralliza	MA - Lichen7097 (coll. Aragón et al.)	Spain, Toledo, Hontanar	875	-4,5	39,6	Juniperus oxicedrus
coralliza	MA - Lichen11334 (coll. Aragón & Martínez)	Spain, Cuenca, Sierra de Valdecabras	1300	-2,03	40,2	Juniperus communis
coralliza	B 600142703 (coll. Sipman)	Greece, Rhodos	100	28,03333333	36,2	Cupressus
coralliza	GZU - Hafellner 56811	Austria, Schladminger Tauern, S of Schladming	1100	13,68333333	47,31666667	Alnus incana
coralliza	GZU - Brunnbauer 5517	Austria, Sankt Aegyd am Neuwalde	820	15,61666667	47,85	Picea abies
coralliza	PRA - Vězda 22176	Croatia, Skrad, Velika Kapela Mts	700	14,9	45,41666667	Fagus sylvatica
coralliza	PRA - Vězda 15640 (coll. Fr. Marc.)	France, Hérault, La Salvetat	800	2,683333333	43,58333333	bark
coralliza	PRA - Vězda 15600	Italy, Sardinia, Macomér	600	8,766666667	40,25	Quercus
coralliza	PRA - Vondrák 8844	Greece, Peloponnese	600	23,35055556	37,61	bark of Arbutus unedo
coralliza	PRA - Vondrák 12618	Spain, Canary Islands, La Palma, Barlovento	1250	-17,83638889	28,80555556	twigs of Pinus canariensis
coralliza	Linda in Arcadia 28SEP2010/30	Greece, Pelopponese, Stoupa	1500	22,331249	36,895178	Abies cephalonica
coralliza	B 600192965 (coll. Sipman)	Greece, East Aegean Islands, Chios	700	26,0375	38,424667	trunk of Pinus brutia
coralliza	B 600192766 (coll. Sipman)	Greece, East Aegean Islands, Chios	690	26,036667	38,424333	trunk of Pinus brutia
coralliza	B 600192782 (coll. Sipman)	Greece, East Aegean Islands, Chios	690	26,036667	38,424333	branch of Juniperus phoenicea
coralliza	GZU (Prügger & Surina 1998)	Slovenia, Snežnik-Javorniki, Veliki Snežnik	885	14,4	45,56666667	Tilia
coralliza	GZU - Mayrhofer 4017, 4018	Greece, Ioannia, Athamanon Mts	1150	21,08	39,51	Abies cephalonica
coralliza	GZU - Magnusson, Lich. Sel. Exs 142	Sweden, Halland, Annestorp	NA	12,09	57,58	Ulmus
coralliza	GZU (Kalb 1968)	France, Corse, Evisa	1250	8,82	42,25	Abies alba
coralliza	GZU (Pittoni 1972)	Slovenia, Ljublana	720	14,35	45,89	blroad-leave tree
coralliza	GZU (Poelt 1972)	Slovenia, Ljublana, Pokojišče	650	14,35	45,89	fruit tree
coralliza	GZU (Grube 1992)	Slovenia, Snežnik-Javorniki, Kozarišče	800	14,46	45,68	Pyrus
coralliza	Ivan Frolov 926	Italy, Sicily, NP Nebrodi	940	14,61416666	37,96316667	Quercus
coralliza	C - Christensen GR321, GR322	Greece, Pades, Mt Smolikas	1800	20,94	40,056	bark of pine stump
coralliza	GZU - Poelt 5851, 5875	Tunisia, Ain Draham	700	8,233333333	36,76666667	Quercus suber
coralliza	PRA - Vondrák 8844	Greece, Peloponnese, Methana	570	23,35	37,6	Arbutus unedo
coralliza	W (Baumgartner 1906)	Croatia, Pelješač Peninsula	300	17,53333333	42,86666667	?
coralliza	C - Christensen 3660	Italy, Sardinia, Lanusei, Barbagia Seulo	1025	9,348	39,817	Quercus ilex
coralliza	C - Christensen 3289a	Greece, Crete, Omalos	1000	23,84	35,362	trunk of Pinus brutia
coralliza	C - Christensen 3217a	Greece, Crete, Omalos	1000	23,84	35,362	Quercus coccifera

coralliza	C - Christensen 9268	Greece, Metsovo, Mt Pirostiá	1725	21,165	39,915	trunk of Pinus heldreichii
coralliza	C - Christensen 3644	Italy, Sardinia, Giara di Gesturi	550	8,986	39,753	Quercus suber
coralliza	C - Christensen 2985	Greece, Crete, Chania, Omalos	1300	23,899	35,315	Quercus coccifera
coralliza	Lucia Muggia 0358-13	Greece, Konitsa, Pigi	940	20,785083	40,055383	Pinus nigra trunk
coralliza	GZU (Kalb, coll. 31.8.1976)	Turkey, Bursa, Ulugağ	1700	29,203843	40,058831	Abies nordmaniana
coralliza	Jiří Malíček 7591	Italy, Sicily, Nebrodi	950	14,61466666	37,96333333	Quercus cerris
coralliza	Linda in Arcadia 29-Aug-2004/L32H, L34H, L35H	Greece, Pelopponese, Patras, Achaia	1400	21,978611	38,154167	Abies cephalonica
coralliza	Jiří Malíček 9418	Croatia, Velebit Mts, Paklenica NP	1180	15,46309	44,365246	bark of Fagus sylvatica
coralliza	GZU - Muggia 0022-19	Greece, Zagori, Vitsa Livadakia	750	20,740982	39,846866	trunk of Quercus pubescens
coralliza	PRA - Vondrák 17905	Spain, Ronda, Sierra de las Nieves	1700	-5,02427	36,68848	trunk and wood of Abies pinsapo
coralliza	Ivan Frolov 1618	Albania, NP Llogara	1200	19,591447	40,198702	on Juniperus oxycedrus
coralliza ?	C - Christensen 3269, 3270	Greece, Crete, Lefka Ori Mts, Omalos	1000	23,89	35,37	wood of Cupressus sempervirens
coralliza ?	C - Christensen 3271a	Greece, Crete, Lefka Ori Mts, Omalos	1000	23,84	35,362	wood of Cupressus sempervirens
coralliza ?	Linda in Arcadia 25-Aug-00/L51H, L52H	Greece, Pelopponese, Kandila	1230	22,390065	37,791234	Abies cephalonica
coralliza ?	Linda in Arcadia 25-Aug-00/L52H	Greece, Pelopponese, Kandila	1230	22,405475	37,799594	Abies cephalonica
coralliza ?	Linda in Arcadia 29-Aug-04/L34H	Greece, Pelopponese, Rakita	1400	21,978687	38,154133	Abies cephalonica
crenularia	Genadii Urbanovichus, s.n. (U027)	Russia, Caucasus Mts, Abrau peninsula, Utrish reserve	150	37,45	44,729	inland sandstone
crenularia	PRA - Vondrák 14556	Russia, Dagestan, Makhachkala	50	47,582764	42,36798	coastal siliceous sandstone
crenularia	GZU - Mayrhofer 20688	Greece, Crete, Orino, Orno Thriptis	785	25,9	35,083333	inland sandstone
crenularia	Ivan Frolov927	Italy, Sicily, Nebrodi	940	14,6144444	37,963056	inland sandstone
crenularia	Jiří Malíček 7574	Italy, Sicily, Mascali	850	15,1305	37,78533333	inland volcanic boulders
crenularia	ERC - Halıcı CL335	Turkey, Kastamonu, Doğanyurt, Köroğlu Village	1350	33,55083333	41,98527778	inland siliceous rock
crenularia	ERC - Halıcı CL467	Turkey, Çanakkale, Lapseki, east of Şevketiye	30	26,88333333	40,39527778	coastal siliceous rock
crenularia	C - Søchting 1709	Great Britain, Devonshire	0	-4,833333333	50,38333333	schist coastal rock
crenularia	C - Søchting 1049	Great Britain, Ingleton	250	-2,466666667	54,16666667	acidic sandstone
crenularia	C - Søchting sin nom	Sweden, Vädäro	0	12,55	56,43333333	acidic coastal sandstone
crenularia	PRA - Vondrák 9615	Sardinia, Fonni	1450	9,283333333	40,06666667	granite in montane zone
crenularia	C - Søchting 5123	Norway, Finnmark, Båtsfjord	50	29,71666667	70,63333333	maritime schist rock
crenularia	C - Søchting 3990, 3988, 3989, 3997, 3388, 6019	Danmark, Bornholm	10	14,86666667	55,15	coastal granite
crenularia	C - Søchting 4089, 4099	Sweden, Öland	10	16,95	57,21666667	quartzite stone at coast

crenularia	C - Søchting 7479	Sweden, Hallands Väderö	10	12,61666667	56,4	coastal granite
crenularia	C - Søchting 3271	Great Britain, Scotland, Dunstaffnage	50	5,433333333	56,45	coastal schist rock
crenularia	C - Søchting 3351	Great Britain, Scotland, Lismore island	50	5,5	56,5	coastal schist rock
crenularia	C - Søchting 1307	Great Britain, Scotland, Mull, Tobermory	20	5,983333333	56,56666667	coastal schist rock
crenularia	C - Søchting 7299	Spain, Galicia, Porto de Son	50	-8,75	42,21666667	coastal granite
crenularia	PRA - Vondrák 2029	Bulgaria, E Rhodopes, Momchilgrad	350	25,41666667	41,46666667	inland base-rich sandstone
crenularia	PRA - Vondrák 6517	Turkey, Sea of Marmara coast, Armutlu	10	28,9	40,46666667	coastal siliceous rock
crenularia	PRA - Vondrák 5724	Iran, Hashtpar (Talesh)	30	48,88333333	38,03333333	coastal siliceous sandstone
crenularia	PRC - Svoboda 788	Czech Republic, Bohemian karst, Kárlštejn	230	14,18333333	49,91666667	inland diabasic rock
crenularia	PRA - Vondrák 4596	Slovakia, Kováčovské kopce hills	150	18,76666667	47,81666667	inland andesitic rock
crenularia	Jiří Malíček 4163	Albania, Burel	700	20,1	41,61666667	inland serpentine rock
crenularia	GZU (Poelt 1986)	Italy, Sardinia, Témpio Pausania	1250	9,066666667	40,88333333	inland granite rock
crenularia	GZU (Poelt 1971)	Great Britain, S Devon, Salcombe	10	3,766666667	50,21666667	coastal schist rock
crenularia	PRA - Palice 7837	Ireland, Beara Peninsula	5	-9,733333333	51,81666667	coastal rock
crenularia	PRA - Palice 16771	Czech Republic, Prague, Motol	320	14,31666667	50,05	inland diabasic rock
crenularia	GZU - Mayrhofer 18011	Greece, Crete, Lassithi, Dafni	550	25,98333333	35,1	inland sandstone
crenularia	PRA - Vězda: Lich. Sel. Exs. 145	Slovakia, Detvanská Polana, Zolná	400	19,21666667	48,61666667	inland andesite rock
crenularia	PRA - Vězda 1566	Bulgaria, Burgas, Tsarevo	10	27,86666667	42,15	maritime rock
crenularia	PRA-V-15537	Slovakia, Vigláš, Mt Rohy	650	19,28333333	48,53333333	inland andesite rock
crenularia	PRA - Vězda 24208	Sweden, Bohuslän, Spekeröd	20	11,83333333	58,01666667	coastal siliceous rock, below overhang
crenularia	Mark Powell 2197	Great Britain, Buckinghamshire, Cliveden	85	-0,683333333	51,55	inland sandstone
crenularia	Mark Powell 3437	Great Britain, Bedfordshire, Riseley	65	-0,483333333	52,25	dust impregnated wood in railway
crenularia	PRA - Vondrák 12162	Turkey, Zonguldak, coastal rocks 1 km W of Türkali	20	31,97305556	41,54277778	coastal siliceous rock
crenularia	PRA - Vondrák 12165	Turkey, Kandıra, Cebeci	20	30,32972222	41,2	coastal siliceous rock
crenularia	PRA - Vondrák 12166	Bulgaria, Burgas, Sinemorets	20	27,96194444	42,07861111	coastal siliceous rock
crenularia	PRA - Vondrák 12169	Georgia, Sarpi (Georgian-Turkish border)	20	41,54944444	41,53277778	coastal siliceous rock
crenularia	PRA - Vondrák 12163	Georgia, Valley of river Acharistskali near Shuakhevi	400	41,96666667	41,61666667	inland siliceous rock
crenularia	PRA - Vondrák 12164	Georgia, Valley of river Acharistskali near Keda	250	41,96666667	41,61666667	inland siliceous rock
crenularia	PRA - Vondrák 12167	Turkey, Kırklareli, Demircihalil	480	27,3	41,83333333	inland siliceous rock
crenularia	PRA - Vondrák 12168	Turkey, Kırklareli, Demircihalil	350	27,3	41,83333333	inland siliceous rock

crenularia	PRA - Vondrák 12171	Turkey, Cide, Denizkonak	20	33,13638889	41,94833333	coastal siliceous rock
crenularia	PRA - Vondrák 12172, 12173	Turkey, Amasra, Kalaycı	20	32,50444444	41,79833333	coastal siliceous rock
crenularia	PRA - Vondrák 12175	Turkey, Kurucaşile, Ovatekkeönü	150	32,64416667	41,8275	coastal siliceous rock
crenularia	Ulf Schiefelbein 1971	Germany, Sachsen-Anhlat, Nebra	150	11,55	51,26666667	xerothermic inland sandstone rock
crenularia	PRA - Vondrák 12584	Turkey, Gaziantep, Nurdağı	950	37,03472222	37,10361111	volcanic outcrop in steppe valley
crenularia	PRA - Vondrák 12590	Great Britain, Scotland, Oban, Balvicar	40	-5,615277778	-61,9025	siliceous coastal rock
crenularia	PRA - Vondrák 12596	Turkey, Kilis, Çukra Köyü	755	37,3025	36,77583333	basaltic flat rock in steppe
crenularia	PRA - Vondrák 12604	Spain, Canary Islands, Tenerife, Parque natural Teno	350	-16,84444444	28,2975	inland volcanic outcrop
crenularia	PRA - Vondrák 12608	Spain, Canary Islands, La Palma, Santa Cruz de La Palma, San Isidro	1450	-17,83833333	28,61388889	volcanic outcrop in forest
crenularia	PRA - Vondrák 12625	Bulgaria, Burgas, Kiten	30	27,77777778	42,22527778	coastal siliceous rock
crenularia	PRA - Vondrák 12631	Spain, Canary Islands, La Palma, Barlovento	1900	-17,85111111	28,77138889	volcanic outcrop in pine forest
crenularia	PRA - Vondrák 12633	Spain, Canary Islands, La Palma, El Passo, Las Manchas	1200	-17,85722222	28,60833333	inland volcanic outcrop
crenularia	PRA - Vondrák 12635	Spain, Canary Islands, La Palma, Barlovento	1700	-17,85111111	28,77138889	volcanic outcrop in pine forest
crenularia	PRA - Vondrák 12636	Spain, Canary Islands, La Palma, Barlovento	1400	-17,83638889	28,80555556	volcanic outcrop in pine forest
crenularia	PRA - Vondrák 12637	Spain, Canary Islands, Tenerife, Vilaflor	1250	-16,65333333	28,14305556	inland volcanic outcrop
crenularia	PRA - Vondrák 12643	Spain, Canary Islands, La Palma, El Passo, Las Manchas	700	-17,87777778	28,605	inland volcanic outcrop
crenularia	B 600141019 (Sipman)	Greece, W Aegean, Nomos Evvias	500	24,538311	38,0848	inland siliceous rock
crenularia	B 600194303 (Sipman)	Greece, East Aegean Islands, Chios	480	25,975	38,565	inland siliceous rock
crenularia	B 600141951 (Sipman)	Greece, W Aegean, Nomos Evvias	250	24,476667	38,008333	inland siliceous rock
crenularia	Jiří Malíček 7423	Italy, Aeolian Islands, Salina Island	400	14,85	38,56666667	inland volcanic boulder
crenularia	C - Christensen GR633	Greece, Metsovo, Perivoli	1350	21,106	39,988	inland serpentine outcrop
crenularia	C - Christensen 8002	Finland, Korpo, Åvensor	20	21,545	60,17	maritime, base-rich siliceous rock
crenularia	PRA - Vondrák 15101	France, Alpes-De-Haute-Provence	830	5,53122	43,99259	inland siliceous stones
crenularia	PRA - Vondrák 17864	Spain, Villablino, Puerto de Leitariegos	1520	-6,42254	43,00159	schist
crenularia	PRA - Vondrák 17882	Spain, Galicia, Viveiro	550	-7,61529	43,61145	granite stonework
crenularia	Ulf Schiefelbein 2144	Germany, Ostvorpommern, Greifswalder Oie	0	13,91666667	54,25	coastal granite
crenularia	PRA - Vondrák 12596	Turkey, Hatay region, Kilis	755	36,775833	37,3025	basaltic flat rock in steppe
crenularia	Ivan Frolov 1006	Spain, Andalusia, Granada, S foothills of Sieerra Nevada	1150	-3,184855	36,973917	inland schist
crenularia	Ivan Frolov 992	Spain, Andalusia, Cádiz, NP Los Alcornocales	600	-5,6355	36,518389	inland sandstone
crenularia	Ivan Frolov 1019	Spain, Andalusia, Cádiz	720	-5,28191	36,774972	inland sandstone

crenularia	Ivan Frolov 1042	Spain, Andalusia, Cádiz, NP Grazalema	1000	-5,429	36,776009	inland sandstone
crenularia	MA - Lichen16139	Portugal, Bragança	968	-6,7	41,8	amphibolite
crenularia	PRA - Vondrák 7119	Crimean Peninsula, Yalta, Oliva	180	33,873056	44,410548	coastal ultrabasic diorite rock
ferruginea	PRA - Vondrák 8254 (90)	Turkey, Gaziköy	20	27,33333333	40,75	Platanus
ferruginea	ERC - Halıcı CL1114	Turkey, Kırklareli Vize	181	27,92583333	41,74027778	Quercus
ferruginea	C - Søchting 12076 (CBFS, dupl.)	Italy, Loano	973	8,2	44,2	Quercus
ferruginea	PRA - Vondrák 7957	Croatia, Baška Voda	30	16,95	43,35	Pinus
ferruginea	GZU - Prügger K225/2	Slovenia, Kazlje	350	13,91666667	45,75	Salix viminalis
ferruginea	GZU - Prügger K224/8	Slovenia, Divaca	430	13,96666667	45,68333333	Acer platanoides
ferruginea	GZU - Prügger K222/5	Slovenia, Lipica	400	13,88333333	45,66666667	Tilia
ferruginea	GZU - Prügger K220	Slovenia, Divaca	430	13,96666667	45,68333333	Quercus pubescens
ferruginea	GZU - Prügger K229/2	Slovenia, Kazlje	350	13,91666667	45,75	Prunus avium
ferruginea	GZU - Prügger K226/6	Slovenia, Črni Kal	380	13,8	45,81666667	Quercus pubescens
ferruginea	PRA - Vondrák 10836	Italy, Calabria, Lazzaro	40	15,68333333	37,95	Quercus cerris
ferruginea	PRA - Vondrák 937	Italy, Sicily, Nebrodi	1200	14,65	37,9	Quercus
ferruginea	Jiří Malíček 7591	Italy, Sicily, Nebrodi	950	14,61466666	37,96333333	Quercus cerris
ferruginea	GZU (Pongratz 1987)	Croatia, Velebit Mts, Lopči	501	15,41666667	44,55	Quercus pubescens
ferruginea	C - Christensen 1462	Greece, Korfu, Nimphes	300	19,729	39,687	Olea europaea
ferruginea	Jiří Malíček 7430	Italy, Sicily, Nebrodi Mts	820	14,48333333	37,96666667	Quercus cerris
ferruginea	C - Christensen 3825	Italy, Sardinia, Vallicciola	1000	9,1299	40,848	Acer pseudoplatanus
ferruginea	C - Christensen 3659	Italy, Sardinia, Lanusei, Barbagia Seulo	1025	9,348	39,817	Quercus ilex
ferruginea	Ivan Frolov 971	France, Gorges Du Verdon	850	6,317	43,762944	Acer monspessulanum
ferruginea	GZU (Nimis, Poelt, Poldini, coll. 4.1985)	Italy, Trieste	260	13,765698	45,710099	bark
ferruginea	GZU - Mayrhofer 17464	Italy, Trieste	280	13,745193	45,737761	Fraxinus ornus
ferruginea	GZU - Poelt 1162x	Slovenia, Ljublana, Pokojišče	400	14,347549	45,894158	Juglans
ferruginea	GZU (Wieser, coll. 6.Nov.1993)	France, Corse, Ponte Leccia	180	9,298891	42,493865	Quercus ilex
ferruginea	GZU - Mayrhofer 7739	Cyprus, Pano Panayia	1000	32,734254	34,973862	Cedrus brevifolia
ferruginea	GZU (Poelt, coll. 8.1984)	Greece, Samos, Pandroso	1050	26,839565	37,731579	Pinus pallasiana
ferruginea	GZU (Erichsen, coll. 6.6.1903)	Germany, Lübeck	10	10,804771	53,963893	Quercus
ferruginea	Linda in Arcadia 24-Apr-2004/L31H	Greece, Pelopponese, Kremasti	900	22,895833	36,971944	Abies cephalonica

ferruginea	Ivan Frolov 999	Spain, Catalonia, Barcelona, outscirts of Santa Maria de Montserrat Abbey	1100	1,811417	41,605107	Quercus ilex
ferruginea	Ivan Frolov 1001	Spain, Catalonia, Barcelona, outscirts of Santa Maria de Montserrat Abbey	1100	1,811417	41,605107	Quercus ilex
ferruginea	Ivan Frolov 1018	Spain, Andalusia, Cádiz, NP Grazalema	1000	-5,429	36,776009	Quercus ilex
ferruginea	Ivan Frolov 993	Spain, Andalusia, Cádiz, NP Los Alcornocales	600	-5,6355	36,518389	Olea
ferruginea	Ivan Frolov 1040	Spain, Andalusia, Cádiz, NP Grazalema	1000	-5,429	36,776009	Quercus faginea
ferruginea	Ivan Frolov 1003	Spain, Catalonia, Barcelona, outscirts of Santa Maria de Montserrat Abbey	1100	1,811417	41,605107	Acer
ferruginea	Poelt12437 (led. Wirth) (GZU)	Germany, Schwarzwald, Baden, Schönau im Schwarzwald	700	7,894167	47,786667	old solitary Fagus sylvatica
ferruginea	Ivan Frolov 1376	France, Massif Central, Aveyron department, Millau	700	3,202347	44,136039	bark of Sorbus aria
ferruginea	Ivan Frolov 1379	France, Massif Central, Aveyron department, Millau	700	3,202347	44,136039	bark of Quercus cf. pubescens
ferruginea	Jiří Malíček 9401	Croatia, Velebit Mts, Paklenica NP	390	15,475919	44,334074	bark of Fagus sylvatica
ferruginea	GZU - Muggia 0490-13	Greece, Konitsa	540	20,670708	40,047442	Carpinus orientalis
festivella	GZU - Oberwinkler 20280	Spain, Canary Islands, Tenerife	750	-16,14916667	28,57333333	volcanic rock
festivella	C - Søchting 1519	Portugal, Madeira, Deserta Grande Island	100	16,51666667	32,53333333	coastal volcanic rock
festivella	C - Søchting 9662, CBFS	Spain, Almeria	20	-2,133333333	36,71666667	maritime siliceous rock
festivella	GZU (Poelt 1987)	Italy, Sardinia, Nuoro, Torre Argentina	25	8,45	40,33333333	maritime siliceous rock
festivella	Ulf Schiefelbein 564	Spain, Catalonia, Serra de Prades, Poblet	700	1,016666667	41,33333333	granite inland rock
festivella	PRA - Vězda: Lich. Sel. Exs. 820 (PRA)	France, Corse, Ajaccio	25	8,733333333	41,91666667	maritime granite
festivella	PRA - Vězda 15629 (coll. Sbarbaro 1956)	Italy, Liguria, Arenzano	30	8,683333333	44,4	siliceous rock
festivella	PRA - Vězda 15600 (coll. Sbarbaro 1956)	Italy, Liguria, Spotorno	50	8,416666667	44,21666667	siliceous rock
festivella	PRA - Vězda 15668	France, Corse, Bastia	70	9,45	42,71666667	siliceous stones
festivella	C - Christenesen 3809	Italy, Sardinia, Bosa	20	8,45	40,3333333	maritime siliceous rock
festivella	PRA - Vondrák 12595	Portugal, Lisbon, Sintra, Castelo dos Mouros	400	-9,389444444	38,79166667	inland siliceous rock in lit forest
festivella	PRA - Vondrák 12598	Portugal, Lisbon, Linhó	180	-9,401111111	38,76472222	inland siliceous rock in lit forest
festivella	PRA - Vondrák 12599	Portugal, Lisbon, Malveira da Serra	390	-9,436666667	38,76388889	inland siliceous rock in lit forest
festivella	PRA - Vondrák 12606	Spain, Canary Islands, Tenerife, Chamorga	300	-16,14916667	28,57333333	volcanic outcrop
festivella	PRA - Vondrák 12611	Spain, Canary Islands, La Palma, Barlovento	600	-17,80138889	28,79	volcanic outcrop
festivella	PRA - Vondrák 12620	Spain, Canary Islands, La Palma, Barlovento	175	-17,78888889	28,84055556	volcanic stones in a rural wall
festivella	PRA - Vondrák 12623	Spain, Canary Islands, Tenerife, Vilaflor	1250	-16,65333333	28,14305556	volcanic outcrop
festivella	PRA - Vondrák 12627	Spain, Canary Islands, Tenerife, Buenavista del Norte	25	-16,9175	28,34305556	volcanic outcrop
festivella	PRA - Vondrák 12630	Spain, Canary Islands, Tenerife, Buenavista del Norte	100	-16,88416667	28,36694444	volcanic outcrop

festivella	PRA - Vondrák 12632	Spain, Canary Islands, La Palma, Barlovento	1000	-17,83638889	28,80555556	volcanic outcrop in forest
festivella	PRA - Vondrák 12634	Spain, Canary Islands, La Palma, El Passo	700	-17,87777778	28,605	volcanic outcrop
festivella	PRA - Vondrák 12638	Spain, Canary Islands, La Palma, El Passo	700	-17,87777778	28,605	volcanic stone
festivella	PRA - Vondrák 13112	Portugal. Madeira, Machico	100	-16,765638	32,712614	maritime volcanic rock
festivella	PRA - Vondrák 13114	Portugal. Madeira, Porto Moniz	30	-17,21167	32,856844	maritime volcanic rock
festivella	van den Boom 46769	Portugal, Azores, Sao Miguel, Nordeste	30	-25,151667	37,85	coastal volcanic rock
festivella	GZU - Mayrhofer 20612	Greece, Crete, Messa Mouliana	445	25,966667	35,183333	coastal siliceous rock
festivella	Ivan Frolov 1045	Spain, Andalusia, NP Gabo de Gata-Nijar, cape Cabo de Gata	240	-2,204056	36,735953	volcanic outcrops, close to sea
festivella	PRA - Vondrák 13735	Portugal, Madeira	50	-16,687061	32,745537	volcanic coastal rock
festivella	PRA - Vondrák 13731	Portugal, Madeira	200	-17,249187	32,803004	volcanic coastal rock
festivella	PRA - Vondrák 13737	Portugal. Lisbon	20	-9,424274	38,994033	sandstone boulder at coast
festivella	PRA - Vondrák 13729	Portugal, Madeira	30	-16,715211	32,743061	volcanic coastal rock
festivella	PRA - Vondrák 13730	Portugal, Madeira	10	-16,89703	32,82967	volcanic coastal rock
festivella	PRA - Vondrák 15358	Portugal, Azores, Ihla do Pico	3	-28,253883	38,390918	coastal volcanic rock
festivella	PRA - Vondrák 15359	Portugal, Azores, Ihla do Pico	30	-28,552953	38,552953	volcanic stone
festivella ?	PRA - Vězda 15547	Sweden, Värmland, Sunnemo	140	13,71666667	59,88333333	inland siliceous rock
festivella ?	LE - Norrlin: Herb. Lich. Fen. 272	Finland, Mikkeli	100	27,274	61,684	siliceous rock
furfuracea	ALTB - Davydov 12284	Kazakhstan, Katon-Karagai	1750	85,563056	49,12	coniferous wood
gennargentuae	GZU (Poelt 1988)	Italy, Calabria, Aspromonte	1720	15,83333333	38,15	alpine siliceous rock
gennargentuae	GZU, PRA - Vězda: Lich. Sel. Exs. 2320	Italy, Calabria, Aspromonte	1750	15,83333333	38,15	alpine siliceous rock
herbidella	PRA - Palice 11832	Turkey, Trabzon, Kalkanlı Mts	2000	39,38333333	40,63333333	Pinus
herbidella	Genadii Urbanavichus, s.n. (coll. 29.6.2013)	Russia, Caucasus Mts, Caucasus reserve, Lagonaki plateau	1800	40,11	44,69333333	Abies nordmanniana
herbidella	Genadii Urbanavichus, s.n. (coll. 27.6.2013)	Russia, Caucasus Mts, Caucasus reserve, Lagonaki plateau	1640	40,12	44,068	Abies nordmanniana
herbidella	Genadii Urbanavichus, s.n. (coll. 21.09.2014)	Russia, Caucasus Mts, Abrau peninsula, Utrish reserve	430	37,4775	44,72	Fraxinus excelsior
herbidella	Genadii Urbanavichus, s.n. (coll. 1.07.2012)	Russia, Caucasus Mts, Caucasus reserve, Lagonaki plateau	1700	40	44,65	Salix
herbidella	PRA - Vondrák 11335	Slovakia, Ulič, Stužica	1000	22,53333333	49,06666667	Acer pseudoplatanus
herbidella	GZU - Bilovitz 3625	Bosnia and Herzegovina, Sutjeska national park	1210	18,68333333	43,3	Ulmus
herbidella	GZU - Bilovitz 3626	Bosnia and Herzegovina, Kulen Vakuf	1450	16,25	44,5	Acer pseudoplatanus
herbidella	PRA - Palice 16756	Slovakia, W Carpathians, Muráň	751	20,03333333	48,75	Quercus
herbidella	GZU - Hafellner 70817	Austria, Styria, Koralpe, Weinebene	1440	15,01666667	46,81666667	Acer pseudoplatanus

herbidella	GZU - Hafellner 67410	Austria, Styria, Ennstalter Alpen, Grossreifling	1000	14,68333333	47,61666667	Acer pseudoplatanus
herbidella	GZU - Hafellner 67428	Austria, Styria, Ennstalter Alpen, Grossreifling	1000	14,68333333	47,61666667	Abies alba
herbidella	GZU (Kalb & Plöbst 1976)	Turkey, Bursa, Uludağ	1700	29,13333333	40,1	Abies nordmanniana
herbidella	GZU - Hafellner 63116	Austria, Styria, Hochschwab, 25 km NW of Kapfenberg	1480	15,1	47,56666667	Larix decidua
herbidella	GZU - Hafellner 62598	Austria, Styria, Hochschwab, 12 km NW of Thörl	950	15,1	47,58333333	Fraxinus excelsior
herbidella	GZU - Hafellner 62826	Austria, Styria, Hochschwab, Leopoldsteiner See	1350	14,83333333	47,56666667	Acer pseudoplatanus
herbidella	GZU - Obermayer 10792	Austria, Styria, Stubalpe, Hirschegg	1260	14,88333333	47,05	Acer pseudoplatanus
herbidella	GZU (Vězda 1983)	Abkhazia, Sukhumi, Pskhu	750	40,8	43,38333333	Alnus barbata
herbidella	GZU - Hafellner 62577	Austria, Styria, Hochschwab, 12 km NW of Thörl	950	15,1	47,58333333	Acer pseudoplatanus
herbidella	GZU - Hafellner 63587	Austria, Styria, Hochschwab, 5 km ENE of Hieflau	660	14,8	47,61666667	Fraxinus excelsior
herbidella	GZU - Hafellner 63301	Austria, Styria, Hochschwab, SW above Seewiesen	1290	15,25	47,6	Fagus sylvatica
herbidella	GZU - Soukup 702, 706	Austria, Styria, Stadl an der Mur	1550	13,96666667	47	Picea abies
herbidella	GZU - Hafellner 58953	Austria, Styria, Triebener Tauern, Trieben	1000	14,48333333	47,45	Alnus incana
herbidella	GZU - Hafellner 63640	Austria, Styria, Hochschwab, 6.7 km E of Hieflau	730	14,83333333	47,6	Fraxinus excelsior
herbidella	GZU - Hafellner 56604	Austria, Styria, Schladminger Tauern, Schladming	1080	13,75	47,31666667	Alnus incana
herbidella	GZU - Hafellner 56861	Austria, Styria, Schladminger Tauern, Schladming	1060	13,68333333	47,31666667	Alnus incana
herbidella	GZU - Mayrhofer 14069	Austria, Styria, Schladminger Tauern, Kleinsölktal	1080	13,88333333	47,3	Alnus incana
herbidella	GZU - Türk 32362	Austria, Styria, Schladminger Tauern, Schladming	1080	13,75	47,31666667	Alnus incana
herbidella	GZU - Bilowitz 267	Austria, Styria, Schladminger Tauern, Kleinsölktal	1200	13,88333333	47,31666667	Alnus incana
herbidella	GZU - Hafellner 52203	Austria, Styria, Triebener Tauern, Trieben	1160	14,55	47,4	Acer pseudoplatanus
herbidella	GZU - Hafellner 52194	Austria, Styria, Triebener Tauern, Trieben	1700	14,53333333	47,4	Acer pseudoplatanus
herbidella	GZU - Soukup 706	Austria, Styria, Stadl an der Mur	1550	13,96666667	47	Alnus incana
herbidella	GZU - Pusswald 5	Austria, Styria, Schladminger Tauern, Kleinsölktal	1040	13,88333333	47,3	?
herbidella	GZU - Mayrhofer 14360, 14441	Austria, Niederösterreich, Türnitzer Alpen, At. Aegyd	950	15,43333333	47,8	Acer pseudoplatanus
herbidella	GZU - Mayrhofer 14360, 14441	Austria, Niederösterreich, Ybbstaler Alpen, Mariazell	1000	15,08333333	47,76666667	Acer pseudoplatanus
herbidella	GZU - Hafellner 72877	Austria, Vorarlberg, Bludenz	1230	9,733333333	47,08333333	Fagus sylvatica
herbidella	GZU - Hafellner 70506	Austria, Styria, Koralpe, Deutschlandsberg	1240	15,06666667	46,08333333	Fagus sylvatica
herbidella	GZU - Bilowitz 2598	Austria, Niederösterreich, Türnitzer Alpen, Mariazell	1060	15,35	47,76666667	Fraxinus excelsior
herbidella	GZU - Bilowitz 3563	Austria, Styria, Mürzsteger Alpen, Schneealpe	1380	15,5	47,71666667	Acer pseudoplatanus
herbidella	GZU - Bilowitz 2443	Austria, Niederösterreich, Türnitzer Alpen, Mariazell	930	15,4	47,76666667	Acer pseudoplatanus

herbidella	GZU - Hafellner 67769	Austria, Styria, Ennstaler Alpen, Admont	1120	14,48333333	47,53333333	Alnus incana
herbidella	GZU - Bilowitz 2612	Austria, Niederösterreich, Türnitzer Alpen, Mariazell	1010	15,35	47,76666667	Fraxinus excelsior
herbidella	GZU - Bilowitz 2210	Austria, Niederösterreich, Türnitzer Alpen, Mariazell	825	15,36666667	47,8	Populus nigra
herbidella	GZU - Hafellner 67480	Austria, Styria, Ennstaler Alpen, Admont	1250	14,61666667	47,53333333	Acer pseudoplatanus
herbidella	GZU - Hafellner 68802	Austria, Styria, Ennstaler Alpen, Admont	1630	14,48333333	47,53333333	Abies alba
herbidella	GZU - Bilowitz 1832	Austria, Styria, Türnitzer Alpen, Mariazell	800	15,35	47,78333333	Tilia
herbidella	GZU - Bilowitz 3100	Austria, Styria, Türnitzer Alpen, Mariazell	1000	15,33333333	47,81666667	Acer pseudoplatanus
herbidella	GZU - Hafellner 70964	Austria, Styria, Koralpe, St. Oswald ob Eibiswald	1280	15,06666667	46,73333333	Acer pseudoplatanus
herbidella	GZU - Bilowitz 3462	Austria, Styria, Mürzsteger Alpen, Schneealpe	1270	15,51666667	47,71666667	Acer pseudoplatanus
herbidella	GZU (Poelt 1990)	Austria, Styria, Ennstaler Alpen, St. Gallen	600	14,61666667	47,68333333	Ulmus
herbidella	GZU - Hafellner 75036	Austria, Styria, Koralpe, St. Katharina	820	15,13333333	46,71666667	Quercus
herbidella	GZU - Hafellner 70657	Austria, Styria, Koralpe, Schwanberg	1720	15,01666667	46,76666667	Sorbus aucuparia
herbidella	GZU - Hafellner 68784	Austria, Styria, Ennstaler Alpen, Admont	1440	14,48333333	47,55	Fagus sylvatica
herbidella	GZU - Wieser 1969	Austria, Styria, Ennstaler Alpen, St. Gallen	700	14,61666667	47,68333333	Abies alba
herbidella	GZU - Hafellner 72377	Austria, Styria, Koralpe, Deutschlandsberg	1415	15,01666667	46,9	Acer pseudoplatanus
herbidella	GZU - Hafellner 80627	Albania, Tirana, Mt Dajt	1060	19,9	41,35	Acer opalus
herbidella	GZU - Türk 46958, 46963	Bosna, Kulen Vakuf	1442	16,25	44,5	Acer pseudoplatanus
herbidella	GZU - Hafellner 80516	Albania, Mat, Mali i Skënderbeut	1230	19,88333333	41,51666667	Acer pseudoplatanus
herbidella	GZU - Hafellner 80502	Albania, Vlorë	1200	19,58333333	40,18333333	Abies borisii-regis
herbidella	GZU - Hafellner 77579	Slovenia, Julian Alps, Log pod Mangartom	700	13,63333333	46,4	branches of Picea abies
herbidella	GZU - Hafellner 77030	Italy, Karnishe Alps, Lago di Sauris	1100	12,7	46,43333333	Alnus
herbidella	GZU - Hafellner 79519	Germany, Bavaria, Ammergauer Alpen, Lindertal	1050	10,9	47,53333333	Salix eleagnos
herbidella	GZU - Hafellner 77226	Switzerland, Berner Alps, Meiringen	1440	8,133333333	46,66666667	Picea abies
herbidella	GZU - Hafellner 63595	Austria, Styria, Hochschwab, 5 km ENE of Hieflau	660	14,8	47,61666667	Salix
herbidella	GZU - Mayrhofer 17867	Montenegro, Rumija, Livari	490	19,21666667	42,1	Castanea sativa
herbidella	GZU - Mayrhofer 17710	Montenegro, Bjelasica, Biogradsko jezero lake	1770	19,61666667	42,88333333	Sorbus aucuparia
herbidella	GZU - Mayrhofer 17610	Montenegro, Bjelasica, Biogradsko jezero lake	1100	19,6	42,88333333	Abies alba
herbidella	GZU (Prügger 1994)	Slovenia, Trnovski Gozd, Nova Gorica	1120	13,63333333	45,95	Acer pseudoplatanus
herbidella	GZU - Hafellner 32546	Italy, Karnishe Alps, Lago di Sauris	1700	12,7	46,43333333	Salix caprea
herbidella	GZU - Hafellner 32597	Italy, Karnishe Alps, Lago di Sauris	1320	12,7	46,43333333	Abies alba

herbidella	GZU (Poelt 1973)	Croatia, Velebit, Gracac	820	15,83333333	44,28333333	?
herbidella	GZU (Poelt 1981)	Germany, Bavaria, Schwaben, Pfronten-Ried	1000	10,55	47,58333333	?
herbidella	GZU - Lich. Graz. 348	Italy, Bolzano, Val di Bráies	1500	12,08333333	46,7	twigs of Picea abies
herbidella	GZU - Prügger SN077.22/1	Slovenia, Snežnik-Javorniki, Veliki Snežnik	1065	14,4	45,56666667	Sorbus aucuparia
herbidella	GZU - Prügger SN014.126/1	Slovenia, Snežnik-Javorniki, Veliki Snežnik	875	14,4	45,56666667	Ulmus glabra
herbidella	GZU - Hafellner 61082	Italy, Veneto, Belluno	1030	12,26666667	46,08333333	Salix
herbidella	GZU (Poelt 1984) ?	Greece, Samos, Pandroso	1050	26,81666667	37,73333333	Pinus pallasiana
herbidella	GZU - Hafellner 61058	Italy, Veneto, Belluno	1030	12,26666667	46,08333333	Picea abies
herbidella	GZU - Wieser 97	Austria, Carinthia, Hermagor	610	13,23333333	46,41666667	Acer pseudoplatanus
herbidella	GZU - Wieser 411	Austria, Carinthia, Hermagor	1000	13,23333333	46,41666667	Fagus sylvatica
herbidella	GZU - Hafellner 75127	Austria, Carinthia, Saualpe, Wolfsberg	1730	14,68333333	46,85	Sorbus aucuparia
herbidella	PRA - Palice 6701	Czech Republic, Jeseníky Mts, Bučina nature reserve	1080	17,18333333	50,05	Ulmus glabra
herbidella	PRA - Vězda 15665	Bulgaria, Pirin Mts, Bansko	1750	23,4	41,75	Abies alba
herbidella	PRA - Hertel: Lich. Alp. 356	Germany, Ammergauer Alpen, Saugrub	910	11,01666667	47,43333333	Acer pseudoplatanus
herbidella	PRA - Vězda 15608	Czech Republic, Hrubý Jeseník Mts, Bělá	1000	17,38333333	50,08333333	Acer pseudoplatanus
herbidella	PRA - Vězda 15610	Slovakia, Malá Fatra Mts, Vrátná dolina valley	750	19,03333333	49,2	Fraxinus excelsior
herbidella	PRA - Vězda 23213	Abkhazia, Caucasus Mts, Sukhumi, Pskhu	750	40,8	43,38333333	Alnus barbata
herbidella	PRA - Vězda: Lich. Sel. Exs. 649	Austria, Tirolia, Stubaier Alpen, Gschnitz	1300	11,35	47,03333333	Alnus incana
herbidella	PRA - Steiner: Lich. Alp. 263	Austria, Tirolia, Stubaier Alpen, Gschnitz	1450	11,35	47,03333333	Picea at timber line
herbidella	PRA - Vězda 22146	Slovakia, Malá Fatra Mts, Vrátná dolina valley	650	19,03333333	49,2	Fraxinus excelsior
herbidella	PRA - Wirth 2592	France, Vogesen Mts, Col du Donon	725	7,133333333	48,5	Acer platanoides
herbidella	PRA - Vězda 22136	Slovakia, Štiavnicke vrchy hills, Mt Sitno	900	18,86666667	48,38333333	Quercus
herbidella	PRA - Vězda 22125	France, Vaucluse, Rustrel	400	5,483333333	43,91666667	?
herbidella	PRA - Vězda 22131	Slovakia, Vysoké Tatry Mts, Mt Pustie	1450	20,11666667	49,16666667	Acer pseudoplatanus
herbidella	Jiří Malíček 5591	Spain, Andalusia, Tolox	1670	-5,016666667	36,68333333	Abies pinsapo
herbidella	PRA - Vondrák 12326	Slovakia, Protected area Stužica	750	22,53333333	49,06666667	Fagus sylvatica
herbidella	PRA - Vondrák 12385	Slovakia, Protected area Stužica	1150	22,53333333	49,06666667	Acer pseudoplatanus
herbidella	PRA - Vondrák 12320	Slovakia, Protected area Stužica	900	22,53333333	49,06666667	Acer pseudoplatanus
herbidella	Jiří Malíček 7012	Germany, Bavaria, Oberammergau	860	11,01666667	47,56666667	old Fraxinus excelsior
herbidella	Jiří Malíček 7003	Germany, Bavaria, Garmisch-Partenkirchen	930	10,86666667	47,46666667	Fagus and Abies

herbidella	PRA - Vondrák 14300	Ukraine, Carpathian Mts, Ugolka	830	23,661366	48,256089	Tilia
herbidella	PRA - Vondrák 14321	Ukraine, Carpathian Mts, Ugolka	720	23,665261	48,256928	Tilia
herbidella	Ivan Frolov 680	Abkhazia, Caucasus Mts, 24 km N of Bzypta	800	40,44333333	43,43555556	trunk of Fraxinus sp.
herbidella	Ivan Frolov 681	Abkhazia, Caucasus Mts	1480	40,6625	43,49861111	trunk of Fagus orientalis
herbidella	Ivan Frolov 684	Abkhazia, Caucasus Mts, 24 km N of Bzypta	800	40,44333333	43,43555556	trunk of Alnus sp.
herbidella	Ivan Frolov 771	Serbia, NP "Tara"	1440	19,3	43,9	Fagus sylvatica
herbidella	Ivan Frolov 768	Serbia, NP "Tara"	1180	19,36666667	43,86666667	Malus sylvestris
herbidella	MA - Lichen6292 (coll. Etayo)	Spain, Tarragona, Monte Caro	1300	0,34	40,8	trunk of Pinus silvestris
herbidella	GZU - Hafellner 67117	Austria, Styria, Ennstaler Alpen, Admont	1500	14,5	47,61666667	Acer pseudoplatanus
herbidella	PRA - Palice 864	Slovakia, NP Slovenský ráj, Hrabušice	750	20,3625	48,913889	Acer pseudoplatanus
herbidella	PRA - Palice 18933	Austria, Sengsengebirge, Hengstpass	1300	14,245	47,784	Acer pseudoplatanus
herbidella	PRA - Palice 18934	Austria, Oberösterreichishe Kalkalpen, Laubabacheralm	850	14,39	47,77	Acer pseudoplatanus
herbidella	PRA - Palice 18932	Czech Republic, Šumava Mts, Mt Stožec	1050	13,827877	48,880605	Acer platanoides
herbidella	C - Christensen s.n.	Croatia, Velebit Mts	1400	15,013	44,811	Fagus
herbidella	PRA - Vondrák 15570	Russia, Caucasus Mts, Maykop, Guzeripl	927	40,14155	43,98677	trunk of Abies nordmanniana
herbidella	PRA - Vondrák 15571	Czech Republic, Vrbno pod Pradědem, Karlova studánka	810	17,3006561	50,0744236	trunk of Tilia cordata
herbidella	PRA - Vondrák 15572	Czech Republic, Vrbno pod Pradědem, Karlova studánka	1290	17,24841	50,07051	trunk of Sorbus aucuparia
herbidella	PRA - Vondrák 15573	Czech Republic, Čeladná, protected area Kněhyně	1240	18,31239	49,49505	trunk of Fagus sylvatica
herbidella	PRA - Vondrák 15224	Russia, Caucasus Mts, Maykop, Guzeripl	1465	40,13073	43,96475	trunk of Carpinus orientalis
herbidella	PRA - Vondrák 15714	Russia, Caucasus Mts, Maykop, plato Lagonaki	1840	40,014	44,07777	trunk of Abies nordmanniana
herbidella	PRA - Vondrák 15893	Russia, Caucasus Mts, Maykop, Guzeripl	1724	40,1473	43,93632	trunk of Fagus sylvatica
herbidella	PRA - Vondrák 16066	Russia, Caucasus Mts, Maykop, Guzeripl	1724	40,1473	43,93632	trunk of Acer trautvetteri
herbidella	PRA - Palice 22023	Czech Republic, Šumava Mts, Mt Plechý	1266	13,857618	48,773462	trunk of Acer pseudoplatanus
herbidella	PRA - Vondrák 16495	Russia, Caucasus Mts, Maykop, plato Lagonaki	1840	40,014	44,07777	trunk of Abies nordmanniana
herbidella ?	PRA - Vondrák 14039	Turkey, Ordu, Çambaşı Yaylası, Gümüşdere Köyü	1600	40,715609	37,932048	bark of Picea orientalis
herbidella ?	GZU - Brunnbauer 6149	Italy, Sardinia, Nuoro, Ussassái	1000	9,383333333	39,8	?
herbidella ?	PRA - Vondrák 10747	Italy, Calabria, Reggio di Calabria	1270	15,85	38,08333333	Abies alba
herbidella ?	C - Christensen 5884, 5899	Greece, Ioannina, Milea, Mt Maurovouni	1450	21,208646	39,86668	trunk of Pinus heldreichii
herbidella subsp. acidophila	PRA - Irina Urbanovichene, s.n.	Russia, S Ural, Zyuratkul	750	59,13333333	54,88333333	Betula
herbidella subsp. acidophila	PRA - Irina Urbanovichene, s.n.	Russia, S Ural, Zyuratkul	750	59,13333333	54,88333333	twigs of Picea obovata

hungarica	PRA - Vondrák: Sel. Exs. Caloplaca 60 (370)	Greece, Peloponnese, Menalo Mts	1200	22,26666667	37,61666667	Abies cephalonica twigs
hungarica	ERC - Halıcı CL495	Turkey, Kastamonu, Pınarbaşi	1050	33,15305556	41,47833333	Juniperus twig
hungarica	ERC - Halıcı CL1322	Turkey, Sinop	795	35,12833333	41,48361111	Quercus
hungarica	PRA - Vondrák 14485	Russia, Dagestan, Gunib	1900	46,921263	42,414789	Pinus sylvestris twigs
hungarica	PRA - Palice16726	Slovakia, W Carpathians, Muráň	460	20,03333333	48,75	Alnus incana
hungarica	C - Søchting 3435, CBFS	Sweden, Ångermanland	150	18,71666667	63,3	Populus
hungarica	C - Søchting 12069, CBFS	Italy, Conio	997	7,8	43,9	Malus
hungarica	C - Søchting 2366	France, Vaucluse	1600	5,266666667	44,16666667	Pinus twigs
hungarica	C - Søchting 5258	Norway, Sogn og Fjordane	300	6,333333333	61,55	twigs of Salix caprea
hungarica	C - Søchting 3432	Sweden, Ångermanland	150	18,71666667	63,3	Populus tremula, twigs
hungarica	GZU - Skant 1603	Austria, Carinthia, Kitschdorf	950	14,56666667	46,85	Fraxinus
hungarica	GZU - Hafellner 21210	Austria, Carinthia, NP Hohe Tauern, Döllach	1550	12,85	46,96666667	Alnus incana
hungarica	GZU - Hafellner 21037	Austria, Carinthia, NP Hohe Tauern, Döllach	1450	12,85	46,96666667	Alnus incana
hungarica	GZU - Skant 1038	Austria, Carinthia, Seetaler Alpen, Wolfsberg	1780	14,83333333	46,83333333	Alnus viridis
hungarica	GZU - Skant 1039	Austria, Carinthia, NP Hohe Tauern, Heiligenblut	1600	12,83333333	47,03333333	wood
hungarica	GZU - Auer 1729	Austria, Carinthia, Karawanken, Rosental	950	13,51666667	46,68333333	Larix twigs
hungarica	GZU (Türk 1981)	Austria, Schladminger Tauern, Lungau	1200	13,8	47,11666667	Sorbus aucuparia
hungarica	GZU (Petutsching 1990)	Austria, Carinthia, Langalmtal	1195	13,71666667	46,83333333	Acer pseudoplatanus
hungarica	GZU - Hafellner 20086	Austria, Carinthia, NP Hohe Tauern, Döllach	1660	12,85	46,96666667	Larix
hungarica	GZU - Hafellner 15139	Austria, Carinthia, NP Hohe Tauern, Mallnitz	1240	13,13333333	47	Alnus incana
hungarica	GZU - Hafellner 15150	Austria, Carinthia, NP Hohe Tauern, Mallnitz	1480	13,25	47,01666667	Salix appendiculata
hungarica	GZU - Schreiner 518	Austria, Carinthia, NP Hohe Tauern, Seebachtal	1280	13	47	Alnus incana
hungarica	GZU - Walther 58	Austria, Carinthia, NP Hohe Tauern, Heiligenblut	1100	12,83333333	47,03333333	Alnus incana
hungarica	GZU - Hafellner 20031	Austria, Carinthia, NP Hohe Tauern, Heiligenblut	1600	12,83333333	47,03333333	Larix twigs
hungarica	GZU (Poelt 1991)	Austria, Tirolia, Ötztaler Alpen, Radurschltal	1470	11	46,95	Picea twigs
hungarica	GZU (Poelt 1981)	Austria, Tirolia, Stubaier Alpen, Gschnitz	?	11,35	47,03333333	wood
hungarica	GZU (Steiner 1972)	Austria, Tirolia, Stubaier Alpen, Gschnitz	1080	11,35	47,03333333	Picea twigs
hungarica	GZU (Steiner 1972)	Austria, Tirolia, Stubaier Alpen, Gschnitz	1080	11,35	47,03333333	Larix twigs
hungarica	GZU (Poelt 1972)	Austria, Tirolia, Rhätische Alpen, Samnaun-Gruppe	1550	10	46,48333333	Alnus incana
hungarica	GZU (Poelt 1972)	Austria, Tirolia, Rhätische Alpen, Samnaun-Gruppe	1250	10	46,48333333	wood

hungarica	GZU (Poelt 1972)	Austria, Tirolia, Rhätische Alpen, Samnaun-Gruppe	1600	10	46,48333333	Picea twigs
hungarica	GZU (Hofer 1986)	Austria, Carinthia, NP Hohe Tauern, Mallnitz	1275	13,2	47,01666667	Alnus incana
hungarica	GZU - Sankt 1533	Austria, Carinthia, Seetaler Alpen, Eberstein	550	14,56666667	46,76666667	wood
hungarica	GZU - Hafellner 13511	Austria, Carinthia, Karawanken, Feistritz	960	14,15	46,48333333	Fraxinus
hungarica	GZU - Hafellner 4805	Austria, Ostalpen, Allgäuer Alpen	1350	10,11666667	47,3	?
hungarica	GZU - Walther 12	Austria, Carinthia, NP Hohe Tauern, Heiligenblut	1600	12,83333333	47,03333333	Larix twigs
hungarica	GZU - Hafellner 15202	Austria, Carinthia, NP Hohe Tauern, Mallnitz	1275	13,25	47,01666667	Alnus incana
hungarica	GZU - Hafellner 15212	Austria, Carinthia, NP Hohe Tauern, Mallnitz	1275	13,25	47,01666667	Salix trunk
hungarica	GZU (Poelt 1994)	Austria, Carinthia, Karawanken, Rosental	800	14,01666667	46,51666667	Ostrya
hungarica	GZU - Hafellner 19839	Austria, Carinthia, NP Hohe Tauern, Heiligenblut	1100	12,83333333	47,03333333	Alnus incana
hungarica	GZU (Poelt 1994)	Austria, Carinthia, Karawanken, Rosental	800	14,01666667	46,51666667	Fraxinus ornus
hungarica	GZU - Skant 1706	Austria, Carinthia, Saualpe, Kliening	990	14,75	46,91666667	Acer pseudoplatanus
hungarica	GZU - Hafellner 13638	Austria, Carinthia, Karawanken, Feistritz	960	14,15	46,48333333	Sambucus nigra
hungarica	GZU - Hafellner 28590	Austria, Carinthia, NP Hohe Tauern, Mallnitz	1250	13,25	47,01666667	Sorbus
hungarica	GZU (Petutsching 1990)	Austria, Carinthia, NP Nockberge	1195	13,93333333	46,95	Prunus padus
hungarica	GZU - Hafellner 28634	Austria, Carinthia, NP Hohe Tauern, Döllach	1650	12,85	46,96666667	Sorbus aucuparia
hungarica	GZU - Hafellner 30384	Austria, Tirolia, Rhätische Alpen, Samnaun-Gruppe	1070	10	46,48333333	Sorbus aucuparia
hungarica	GZU - Hafellner 57738	Austria, Styria, Gleinalpe, St. Michael	1200	15,06666667	47,26666667	Fagus sylvatica
hungarica	GZU - Mayrhofer 14063	Austria, Schladminger Tauern, Kleinsölktal	1080	13,88333333	47,3	Alnus incana
hungarica	GZU - Hafellner 53268	Austria, Niedere Tauern, Oberwölz	920	14,26666667	47,2	Corylus avelana
hungarica	PRA - Palice 16998	Slovakia, W Carpathians, Muráň	619	20,06666667	48,76666667	Quercus cerris
hungarica	PRA - Palice 11569	Sweden, Jämtland, Åre, Handöl	655	12,43333333	63,73333333	Populus tremula
hungarica	GZU (Wieser 1993)	Italy, Karnishe Alps, Lago di Sauris	1650	12,7	46,43333333	Salix
hungarica	Hermansson 4729a	Sweden, Dalarna, Drevsjön	790	12,33333333	61,65	Salix caprea
hungarica	UPS (Hermansson 14035)	Sweden, Dalarna: Idre par., Lillflon-Gillmyren	750	12,78333333	61,78333333	Populus tremula
hungarica	BG (Ihlen 250)	Norway, Rogaland: Suldal, Nesfalten at lake Suldalsvatnet	100	6,799722222	59,64305556	Sorbus aucuparia
hungarica	in sample of B. coralliza, PRA - Vězda 22176	Croatia, Skrad, Velika Kapela Mts	700	14,9	45,41666667	Fagus sylvatica
hungarica	Jiří Malíček 3104	Italy, Alps, Trentino	1000	11,16666667	46,43333333	twigs of Larix decidua
hungarica	PRA - Palice5665	Slovakia, Muránska planina Mts, loc. Poludnica	570	20,03333333	48,75	Quercus
hungarica	PRA - Palice5308	Slovakia, Muránska planina Mts, loc. Cigánka	900	20,06666667	48,75	Tilia

hungarica	PRA - Palice354	Slovakia, Muránska planina Mts, loc. Poludnica	890	20,06666667	48,75	Fagus
hungarica	Ivan Frolov 770	Serbia, NP "Uvac", Kanyevina	1000	19,98333333	43,35	Juniperus communis
hungarica	PRA - Palice18699	Austria, Salzburg, Bucheben	1210	12,98638889	47,12472222	Alnus incana
hungarica	PRA - Palice18667	Austria, Salzburg, Bucheben	1195	12,97777778	47,12638889	wood of fence
hungarica	PRA - Palice18484	Slovakia, NP Slovenský kras	440	20,40638889	48,57166667	Quercus
hungarica	Linda in Arcadia 29-Aug-2004/L31H	Greece, Pelopponese, Vasiliki forest	1500	22,329167	36,895833	Abies cephalonica
hungarica	Jiří Malíček 7798	Macedonia, Suva Gora Mts, Shishevo, starting point to Matka canyon	300	21,296955	41,961397	bark of Alnus
hungarica	PRA - Vondrák 15127	France, Lozére	1000	3,5468	44,41644	Pinus nigra twigs
hungarica	PRA - Palice 21866	Norway, Sogn og Fjordane, Eid, Nordfjordeid	215	6,130838	61,969826	Betula twig
hungarica	PRA - Palice 21902	Norway, Nord-Trøndelag, Leka, Leka Island	35	11,667323	65,102538	Salix caprea twig
hungarica	PRA - Vondrák 15151	Russia, Caucasus Mts, Maykop, Guzeripl	1465	40,13073	43,96475	twigs of Fagus orientalis
hungarica	PRA - Vondrák 15569	Russia, Caucasus Mts, Maykop, Guzeripl	927	40,14155	43,98677	twigs of Fagus orientalis
hungarica	Ivan Frolov 1687	Greece, Mt Olympus	1650	22,381695	40,081802	Pinus heldreichii
hungarica	Ivan Frolov 1657	Greece, Konitsa, Mt Smolikas	1900	20.906426 E	40,057701	Pinus heldreichii
hungarica	Ivan Frolov 1692	Greece, Mt Olympus	1980	22,373015	40,082056	on twigs of Pinus heldreichii
hungarica	Jiří Malíček 11401	Switzerland, Berner Alps	1740	46,452501	7,748047	Picea abies trunk
hungarica ?	GZU (Prügger 2000)	Slovenia, Illirska Bistrica	660	14,33333333	45,46666667	Rhamnus fallax
hungarica ?	GZU - Prügger K226/6	Slovenia, Črni Kal	380	13,8	45,81666667	Quercus pubescens
hungarica ?	ERC - Halıcı CL735	Turkey, Denizli, Buldan	1220	29,25	37,66055556	Pinus nigra
hungarica ?	ERC - Halıcı CL474	Turkey, Eskişehir, Mihalgazi, north of Bozdağ	1130	30,60222222	39,94194444	Salix
hungarica ?	C - Christensen 5669	Greece, Piéria, Mt Ólimbos	1600	22,45	40,1	twigs of Pinus heldreichii
hungarica ?	PRA - Vězda: Lich. Sel. Exs. 1818 (PRA)	Serbia, Zlatibor, between Kokin Brod and Užice	750	19,85	43,63333333	Pinus silvestris, trunk
lauri	PRA - Vondrák 13109	Portugal, Madeira, Curral das Freiras	1000	-16,963002	32,711423	bark of Castanea sativa
lauri	C - Søchting 3274	Great Britain, Scotland, Dunstaffnage	50	-5,433333333	56,45	Fagus sylvatica
lauri	C - Søchting 3328	Great Britain, Scotland, Benderloch	50	-5,4	56,48333333	Sorbus aucuparia
lauri	GZU (Poelt 1992)	Great Britain, Scotland, Morvern	10	-5,75	56,56666667	Corylus avelana
lauri	PRA - Vondrák 12563	Great Britain, Scotland, Lochgilphead, Tayvallich	20	-5,629166667	56,00388889	Crataegus twigs
lauri	PRA - Vondrák 12564	Great Britain, Scotland, Oban, Balvicar	40	-5,623611111	56,27888889	Ilex aquifolium
lauri	PRA - Vondrák 12601	Spain, Canary Islands, La Palma, San Isidro	1050	-17,81777778	28,64472222	bark of Castanea sativa
lauri	PRA - Vondrák 12602	Spain,Canary Islands, La Palma, San Isidro	1050	-17,81777778	28,64472222	bark of Castanea sativa

lauri	PRA - Vondrák 12624	Spain, Canary Islands, La Palma, Barlovento	1200	-17,83638889	28,80555556	bark of Lauraceae tree
lauri	PRA - Vondrák 12644	Spain, Canary Islands, La Palma, Barlovento	1000	-17,83638889	28,80555556	twigs
lauri	PRA - Vondrák 12121	Spain, Canary Islands, La Palma, Barlovento, Los Sauces	1200	-17,81444444	28,785	twigs of Pinus canariensis
lauri	PRA - Vondrák 12124	Spain, Canary Islands, La Palma, Barlovento, Los Sauces	940	-17,81444444	28,785	decideous tree
lauri	PRA - Vondrák 12125	Spain, Canary Islands, La Palma, El Passo, Las Manchas	1200	-17,85722222	28,60833333	bark of Castanea sativa
lauri	PRA - Vondrák 12127	Spain, Canary Islands, La Palma, San Isidro	1200	-17,81777778	28,64472222	bark of Laurus
lauri	PRA - Vondrák 12129	Spain, Canary Islands, La Palma, San Isidro	1450	-17,83277778	28,61222222	Salix shrub
lauri	PRA - Vondrák 12131	Spain, Canary Islands, La Palma, Barlovento, Los Sauces	1050	-17,81444444	28,785	twigs of Pinus canariensis
lauri	PRA - Vondrák 12132	Spain, Canary Islands, La Palma, San Isidro	650	-17,80027778	28,63027778	twigs of Ficus carica
lauri	PRA - Palice 8020	Ireland, Glengarriff Wood	20	-9,55	51,75	Alnus
lauri	GZU (Poelt 1992)	Great Britain, Scotland, Westerness, Morvern	10	-5,798547	56,574243	Corylus avelana
monticola	Ivan Frolov 500	Russia, S Ural, Bashkir natural reserve	820	57,06666667	53,33333333	wood of Juniperus sibirica
monticola	GZU (Mayrhofer 1976)	Macedonia, Galiĉica, Prespansko jezero	1600	20,81666667	40,95	wood
monticola	GZU - Hafellner 80578	Albania, Bjeshkët e Nemuna Mts, Teth	1400	19,76666667	42,43333333	wooden stump of Pinus heldraichii
monticola	GZU (Poelt 1984)	Italy, Trentino, Passo di Rolle	2150	11,78333333	46,3	wood of twigs
monticola	PRA- Vězda: Lich. Sel. Exs. 1812	Austria, Salisburgia, Schladminger Tauern Mts, Lungau	1320	13,68333333	47,25	wood
monticola	PRA - Vězda: Lich. Sel. Exs. 1273	Switzerland, Wallis, Zermatt	1800	7,716666667	46	wood
monticola	PRA - Vězda 15596	Slovakia, Nízké Tatry Mts, Pusté Pole	950	19,51666667	48,93333333	wood of Juniperus communis
monticola	ERC - Halıcı CL166	Turkey, Çorum, Kargı, Gökçedoğan Köyü kuzeybatısı	1585	34,675	41,19861111	wood Pinus sylvestris
monticola	GZU - Hafellner 80544	Albania, Bjeshkët e Nemuna Mts, Boga	1600	19,75	42,38333333	Fagus sylvatica
monticola	GZU - Mayrhofer 17736	Montenegro, Bjelasica, Biogradsko jezero lake	1770	19,61666667	42,88333333	Abies alba
monticola	GZU - Hafellner 72732	Lichtenstein, Rätikon	1750	9,6	47,08333333	Larix decidua
monticola	GZU - Hafellner 75717	Austria, Carinthia, Seetaler Alpen, Wolfsberg	1720	14,65	46,81666667	Sorbus aucuparia
monticola	GZU - Hafellner 69437	Italy, Piemonte, Pinerolo	2350	7,116666667	44,88333333	twigs of Rhododendron
monticola	PRA - Vězda 22151	Slovenia, Julian Alps, Mt Vršič	2000	13,71666667	46,41666667	Larix decidua
monticola	Jiří Malíček 5394	Austria, Alps, NP Hohe Tauern	1740	12,1	47,16666667	Rhododendron ferrugineum
monticola	Jiří Malíček 6980	Macedonia, NP Galičica	1540	20,81888889	40,95333333	Juniperus wood
monticola	PRA - Vondrák 12576	Turkey, Kahramanmaraş, Andırın, Dilek Dağı	1580	36,33888889	37,76222222	bark of solitary Cedrus libanii
monticola	PRA - Vondrák 12583	Turkey, Kahramanmaraş, Andırın, Dilek Dağı	1580	36,33888889	37,76222222	bark of Pinus nigra at forest edge
monticola	PRA - Vondrák 12586	Turkey, Mersin, Anamon, Abaqnoz Yaylasi	1760	32,8	36,35	bark of Cedrus libanii

monticola	GZU (Poelt 1980)	Switzerland, Filisur, Val Tuors	1900	NA	NA	Rhododendron twigs
monticola	Ivan Frolov 765	Serbia, Stara Planina Mts, Kalna	1600	22,6	43,36666667	Juniperus nana
monticola	ALTB - Davydov 5220 (sub C. ferruginea)	Russia, Altai Mts	1200	83,0833333	51,083333	Abies sibirica
monticola	C - Christensen 4219	Greece, N Pindos, Mt Augo	1800	21,028	39,868	branch of Pinus heldrechii
monticola	C - Christensen 5897	Greece, Pades, Mt Smolikas	1825	20,940057	40,056222	base of Pinus heldreichii
monticola	C - Christensen 5898	Greece, Metsovo, Mt Maurovouni	1850	21,17331	39,844652	trunk of Pinus heldreichii
monticola	C - Christensen 5979	Greece, Grevena, Avdella, Mt Koleo	1865	21,091389	40,006409	base of Pinus heldreichii
monticola	C - Christensen 5973	Greece, Grevena, Avdella, Mt Koleo	1775	21,0913	40,0064	base of Pinus heldreichii
monticola	PRA - Vondrák 13167	Russia, S Ural Mts, Mt Bolshoy Shelom	1150	58,31	54,513056	wood of Juniperus sibirica twig
monticola	PRA - Vondrák 15099	France, Hautes-Alpes	1840	6,719706	44,929099	Larix decidua bark
monticola	PRA - Vondrák 15102	Switzerland, Alps	1936	8,36847	46,47782	Rhododendron ferrugineum
monticola	Jiří Malíček 9440	Slovenia, Julian Alps, Triglav NP	1500	13,749966	46,439963	bark of Larix decidua
monticola	MA - Lichen13193 (coll. Etayo)	Spain, Huesca, Benasque	1870	0,5	42,6	wood of Pinus uncinata
monticola	Ivan Frolov 1641	Greece, Konitsa, Mt Smolikas	1900	20,906426	40,057701	on Pinus heldreichii
monticola	Ivan Frolov 1644	Greece, Konitsa, Mt Smolikas	1900	20,906426	40,057701	on Pinus heldreichii, on base of trunk
monticola	Ivan Frolov 1602	Albania, NP Llogara	1850	19,591447	40,198702	on trunks of Pinus heldreichii
monticola / anatolica	GZU (Kalb 1976)	Turkey, Bursa, Uludağ	1950	29,13333333	40,1	Abies nordmanniana
monticola / anatolica	PRA (Kalb 1976)	Turkey, Bursa, Uludağ	2150	29,13333333	40,1	Abies nordmanniana, above timber line
monticola / coralliza	C - Christensen 5894	Greece, Ioannina, Milea, Mt Maurovouni	1450	21,208646	39,86668	trunk of Pinus heldreichii
monticola / coralliza	C - Christensen 4041, 4049	Greece, Metsovo, Katára pass	1680	21,227315	39,792255	trunk of Pinus heldreichii
monticola ?	PRA - Vězda: Lich. Sel. Exs. 1813	Georgia, Chokhautauri	2200	42,23333333	42,05	Abies trunk
monticola ?	C- Christensen 5895	Greece, Ioannia, Milea, Mt Maurovouni	1450	21,196115	39,834807	trunk of Pinus heldreichii
palmae	PRA - Vondrák 12573	Portugal, Lisbon, Malveira da Serra, Biscaia	120	-9,476111111	38,75388889	twigs of Phillyrea latifolia
palmae	PRA - Vondrák 12589	Portugal, Lisbon, Malveira da Serra, Biscaia	120	-9,476111111	38,75388889	twigs of Quercus coccifera
palmae	PRA - Vondrák 12591	Portugal, Lisbon, Malveira da Serra, Biscaia	50	-9,476111111	38,75388889	twigs of Juniperus phoenicaea
palmae	PRA - Vondrák 12592	Portugal, Lisbon, Malveira da Serra, Figueira do Guincho	60	-9,471666667	38,75138889	twigs of Rosmarinum vulgare
palmae	PRA - Vondrák 12593	Portugal, Lisbon, Sesimbra	40	-8,968888889	38,48444444	bark of Ceratonia siliqua
palmae	PRA - Vondrák 12594	Portugal, Lisbon, Malveira da Serra, Biscaia	100	-9,476111111	38,75388889	twigs of Cystus
palmae	PRA - Vondrák 12597	Portugal, Lisbon, Malveira da Serra, Guincho	10	-9,47	38,73194444	twigs of Juniperus phoenicaea
palmae	PRA - Vondrák 12609	Spain, Canary Islands, La Palma, El Passo	1000	-17,84833333	28,68527778	bark of Amygdalus

palmae	PRA - Vondrák 12610	Spain, Canary Islands, La Palma, El Passo, Las Manchas	700	-17,87777778	28,605	bark of Ficus carica
palmae	PRA - Vondrák 12612	Spain, Canary Islands, La Palma, El Passo, Las Manchas	700	-17,87777778	28,605	twigs of Pinus canariensis
palmae	PRA - Vondrák 12614	Spain, Canary Islands, Tenerife, Macizo de Anaga	700	-16,30694444	28,53027778	twigs of Pinus canariensis
palmae	PRA - Vondrák 12615	Spain, Canary Islands, Tenerife, Macizo de Anaga	700	-16,30694444	28,53027778	twigs of Castanea sativa
palmae	PRA - Vondrák 12617	Portugal, Lisbon, Malveira da Serra, Guincho	10	-9,47	38,73194444	wood living Cupressus sempervirens
palmae	PRA - Vondrák 12619	Spain, Canary Islands, La Palma, Santa Cruz de La Palma	1050	-17,81777778	28,64472222	bark of Castanea sativa
palmae	PRA - Vondrák 12621	Spain, Canary Islands, La Palma, El Passo, Las Manchas	700	-17,87777778	28,605	bark of Amygdalus
palmae	PRA - Vondrák 12622	Spain, Canary Islands, Tenerife, Vilaflor	1250	-16,65333333	28,14305556	bark of Euphorbiaceae shrub
palmae	PRA - Vondrák 12626	Spain, Canary Islands, Tenerife, Macizo de Anaga	700	-16,30694444	28,53027778	bark of Erica
palmae	PRA - Vondrák 12628	Spain, Canary Islands, Tenerife, Macizo de Anaga	700	-16,30694444	28,53027778	bark of Euphorbiaceae shrub
palmae	PRA - Vondrák 12640	Spain, Canary Islands, La Palma, El Passo, Las Manchas	700	-17,87777778	28,605	bark of Ficus carica
palmae	PRA - Vondrák 12642	Spain, Canary Islands, La Palma, El Passo, Las Manchas	1100	-17,85722222	28,60833333	bark of Fabaceae shrub
palmae	PRA - Vondrák 12110	Spain, Canary Islands, La Palma, Barlovento	1250	-17,83638889	28,80555556	bark of Castanea sativa
palmae	PRA - Vondrák 12113	Spain, Canary Islands, La Palma, El Passo, Las Manchas	1200	-17,85722222	28,60833333	twigs of Pinus canariensis
palmae	PRA - Vondrák 12116	Spain, Canary Islands, La Palma, Barlovento	1250	-17,83638889	28,80555556	twigs of Pinus canariensis
palmae	PRA - Vondrák 12118	Spain, Canary Islands, La Palma, Barlovento	1150	-17,81444444	28,785	twigs of Pinus canariensis
palmae	PRA - Vondrák 12119	Spain, Canary Islands, La Palma, Barlovento	1050	-17,81444444	28,785	twigs of Pinus canariensis
palmae	PRA - Vondrák 12126	Spain, Canary Islands, La Palma, El Passo, Las Manchas	1200	-17,85722222	28,60833333	bark of Castanea sativa
palmae	PRA - Vondrák 12130	Spain, Canary Islands, La Palma, Barlovento	1050	-17,81444444	28,785	twigs of Pinus canariensis
palmae	PRA - Vondrák 12133	Spain, Canary Islands, La Palma, Barlovento	1150	-17,81444444	28,785	twigs of Pinus canariensis
palmae	PRA - Vondrák 12141	Spain, Canary Islands, La Palma, El Passo, Las Manchas	1120	-17,85722222	28,60833333	twigs of Pinus canariensis
palmae	PRA - Vondrák 12143	Spain, Canary Islands, La Palma, Santa Cruz de La Palma	1450	-17,83833333	28,61388889	twigs of Pinus canariensis
palmae	Poelt 2803 (GZU)	Portugal, Tavira	20	-7,672319	37,129984	bark
palmae	Ivan Frolov 1007	Spain, Andalusia, Cádiz, NP Barbate	30	-5,997927	36,182399	Juniperus phoenicea
palmae	PRA - Vondrák 13734	Portugal, Madeira, Agua de Pena	100	-16,765638	32,712614	Ficus carica
palmae	PRA - Vondrák 15356	Portugal, Azores, Ihla do Pico	200	-28,32143	38,508026	bark of Castanea sativa
palmae	PRA - Vondrák 15357	Portugal, Azores, Ihla do Pico	10	-28,447854	38,422738	bark of Ficus carica
palmae	PRA - Vondrák 17871	Spain, Andalusia, Tarifa, Bolonia	150	-5,798198	36,095082	twigs of Pistacia lentiscus
palmae	PRA - Vondrák 17887	Spain, Andalusia, Tarifa	380	-5,72288	36,08557	twigs of Sarothamnus
palmae	PRA - Vondrák 17888	Spain, Andalusia, Tarifa	270	-5,71681	36,08632	trunk and twigs of Olea europaea

palmae	PRA - Vondrák 17894	Spain, Andalusia, Tarifa	220	-5,71803	36,08203	twigs of Pistacia lentiscus
palmae	PRA - Vondrák 17900	Spain, Andalusia, Tarifa	250	-5,7941	36,09944	bark of Eucalyptus
palmae ?	GZU - Hafellner 10761 (coll. Brunner 1983)	Portugal, prov. Ribatejo	100	-8,32653	39,512468	bark
psychrophila	ERC - Halıcı CL264	Turkey, Kayseri, Erciyes Mountain	1725	35,51333333	38,61416667	siliceous rock
psychrophila	ERC - Halıcı CL679	Turkey, Afyon, Sandıklı, Çakmaktepe Pass	1500	32,26194444	40,31027778	siliceous rock
psychrophila	GZU (Poelt 1976)	Italy, Alps, Passo di Rolle	2000	11,78333333	46,3	siliceous rock in alpine zone
psychrophila	GZU - Nowak: Lich. Pol. Merid. Exs. 203 (1976)	Poland, Krkonoše Mts, Mały Kocioł Snieżny	1300	15,55	50,76666667	bazalt rock in subalpine zone
psychrophila	GZU - Bellemere & Hafellner 9549, 1980	France, Massif Central, Auvergne, Mt Puy de Sancy	1820	2,8	45,51666667	andesite rock
psychrophila	GZU (Poelt 1978) & (Mayrhofer 1978)	Italy, N Apenines, Abetone	1800	10,7	44,15	sandstone in alpine zone
psychrophila	ERC - Halıcı CL1012	Turkey, Aksaray, Büyük Hasan Mountain	1960	34,40472222	38,32333333	siliceous rock
psychrophila	GZU (Vězda 1975)	Macedonia, Šar Planina Mts, Tetovo, Popova Šapka	2000	20,8	42,01666667	schist rock in alpine zone
psychrophila	BRA (Nádvorník 1929)	Ukraine, E Carpathians, Polonina Borzhava Mts, Mt Stoy	1600	23,18333333	48,61666667	sandstone in subalpine zone
psychrophila	Ivan Frolov 764	Serbia, Stara Planina Mts, Kalna	1600	22,6	43,36666667	vertical side of base-rich siliceous rock, in subalpine belt
psychrophila	GZU 000327974 (coll. Rohrer)	Kosovo, Šar Planina Mts	2173	20,68006	41,907198	siliceous rock
psychrophila	GZU 000328070 (coll. Rohrer)	Kosovo, Šar Planina Mts	2416	20,73638	41,883012	siliceous rock
psychrophila	Ivan Frolov 1398	France, Massif Central, Monts du Cantal, Mt Puy Mary	1770	2,676483	45,109324	vertical surface of siliceous outcrops, in alpine belt
psychrophila	GZU - Alexander Rohrer K12.18	Kosovo, Šar Planina Mts, Dragaš	2542	20,749856	41,898304	alpine schist rock
psychrophila	Ivan Frolov 1652	Greece, Konitsa, Mt Smolikas	2200	20,910031	40,090836	on horizontal surface of serpentine stone in shade of
psychrophila	Ivan Frolov 1650	Greece, Konitsa, Mt Smolikas	2200	20,910031	40,090836	on horizontal surface of serpentine stone in shade of
purpurea	PRA - Vondrák 12639	Spain, Canary Islands, La Palma, Barlovento, Los Sauces	1000	-17,81444444	28,785	volcanic outcrop in forest
purpurea	PRA - Vondrák 12629	Spain, Canary Islands, La Palma, Las Manchas	1200	-17,857789	28,608117	volcanic outcrop in forest
relicta	C - Søchting 9995	Spain, Guadalaja, Torremocha	1230	-2,083333333	40,93333333	Quercus
relicta	MA - Lichen15052	Spain, Cuidad Real, Fuencaliente	700	-4,3	38,4	trunk of Alnus glutinosa
relicta	C - Søchting 6662	Norway, Katterat	200	17,96666667	68,4	Salix
relicta	C - Søchting 2555	Denmark, Jutland, Gjessø	50	-5,483333333	56,1	Fagus sylvatica
relicta	C - Søchting 6990	Norway, Flatanger	60	10,75	64,45	Salix caprea
relicta	C - Søchting 6987	Norway, Flatanger	80	10,75	64,45	Sorbus aucuparia
relicta	C - Søchting 6660	Norway, Nordland, Katterat	201	17,95	68,38333333	Sorbus aucuparia
relicta	PRA - Vězda: Lich. Sel. Exs. 1220	Sweden, Härjedalen: Tännäs, Kvarnbäckstjärn	370	17,36666667	63,93333333	Salix caprea
relicta ?	C - Søchting 6663	Norway, Nordland, Katterat	200	17,95	68,38333333	Populus tremula

remota	GZU - Obermayer 8802	China, Sichuan, Kangding	3000	101,9833333	29,75	Salix
remota	GZU - Obermayer 9887	China, Sichuan, Kangding	3070	101,9833333	29,75	twigs of Rosa
remota	GZU - Obermayer 9060	China, Sichuan, Kangding	3170	101,9666667	29,56666667	twigs of Rhododendron
remota	GZU - Obermayer 8189	China, Sichuan, Kangding	3070	101,9833333	29,75	Salix twigs
remota	GZU - Obermayer 8993	China, Sichuan, Kangding	3070	101,9833333	29,75	Salix twigs
remota	GZU - Obermayer 8796	China, Sichuan, Kangding	3150	101,9666667	29,56666667	Salix twigs
scabrosa	Josef P. Halda 5521	Czech Republic, Hrubý Jeseník Mts, Velká kotlina	1250	17,23333333	50,05	base-rich phyllite
scabrosa	GZU (Poelt 1972)	Sweden, Torne Lappmark, Stenbacken, Luopakte	820	19,45	68,21666667	siliceous rock
scabrosa	Ivan Frolov 668	Abkhazia, Caucasus Mts, NP Ritsinskiy	2050	40,68194444	43,47472222	big base rich siliceous stone, under overhang
scabrosa	MRAM - L 49620	Poland, High Tatra Mts	2135	20,051718	49,188607	siliceous rock
subathallina	PRA - Vondrák 12134	Spain, Canary Islands, La Palma, Barlovento	1150	-17,81444444	28,785	twigs of Pinus canariensis
subathallina	PRA - Vondrák 12135	Spain, Canary Islands, La Palma, Barlovento	1050	-17,81444444	28,785	twigs of Pinus canariensis
subathallina	B 600194367 (coll. Sipman)	Greece, East Aegean Islands, Chios	650	25,925	38,543333	branches of Prunus cocomilia
subathallina	B 600194216 (coll. Sipman)	Greece, East Aegean Islands, Chios	625	25,993333	38,565	trunk of Pinus brutia
subathallina	B 600192769 (coll. Sipman)	Greece, East Aegean Islands, Chios	690	26,036667	38,424333	trunk of Pinus brutia
subathallina	C - Søchting 9647	Spain, Almeria	5	-2,7	36,68333333	Mediterranean shrubs
subathallina	C - Søchting 7312	Spain, Lugo	600	-7,316666667	42,88333333	twigs of Quercus ilex
subathallina	PRA - Vondrák 11881	Italy, Sardinia, Olbia, San Pantaleo	100	9,433333333	41,03333333	Phillyrea latifolia
subathallina	PRA - Vĕzda 15662	Bosna and Herzegovina, Adriatic coast at village Neum	20	17,6	42,91666667	Pistacia lentiscus
subathallina	ERC - Halıcı CL600	Turkey, Bilecik, Gölpazarı, southeast of Büyüksusuz Village	480	30,20472222	40,25111111	Juniperus
subathallina	Linda in Arcadia 10-Dec-2005/LJH	Greece, Methana, Agios Nikolaos	200	23,354867	37,633204	Ficus carica
subathallina	GZU (Poelt & Clauzade, coll. 17.7.1970)	France, Vaucluse, Rustrel	380	5,481626	43,932167	bark and wood
subathallina	Linda in Arcadia 11-Mar-2003/L49H	Greece, Pelopponese, Elis, Vrina	432	21,650916	37,540527	Pinus halepensis
subathallina	Ivan Frolov 1032	France, Alpes-de-Haute-Provence, Gorges Du Verdon	850	6,317	43,762913	Pistacia terebinthus
subathallina	Ivan Frolov 990	Spain, Andalusia, Cádiz, NP Grazalema, Sierra del Endrinal	1400	-5,386483	36,738536	Pinus halepensis
subathallina	PRA - Vondrák 17892	Spain, Castilla y León, Tiedra, Villardefrades	900	-5,21814	41,69291	twigs of Quercus ilex
subathallina	PRA - Vondrák 17893	Spain, Castilla y León, Astorga	1020	-6,12629	42,48926	twig of Calluna vulgaris
subathallina	PRA - Vondrák 17895	Spain, Castilla y León, Astorga	1020	-6,12629	42,48926	twigs of Quercus ilex
subathallina	PRA - Vondrák 17902	Spain, Castilla y León, Tiedra, Villardefrades	900	-5,21814	41,69291	thick branch of Quercus ilex
subathallina ?	ERC - Halıcı CL495	Turkey, Kastamonu, Pınarbaşı, southeast of Karaağaç Village	1050	33,15305556	41,47833333	Juniperus

xerothermica	MA - Lichen10618	Spain, Teruel, Villar del Cobo	1700	-1,6	40,4	trunk of Pinus sylvestris
xerothermica	C - Søchting 9995 in sample of B. croatica, CBFS	Spain, Guadalajara, Torremocha	1230	-2,083333333	40,93333333	Quercus
xerothermica	PRA - Vondrák 8822	Greece, Kalampaka	450	21,61666667	39,7	shrub bark
xerothermica	ERC - Halıcı CL1060	Turkey, Antalya, Korkuteli	1300	30,1	37,01666667	Pinus brutia twigs and bark
xerothermica	ERC - Halıcı CL600	Turkey, Bilecik	480	30,20472222	40,25111111	Juniperus twigs
xerothermica	PRA - Vondrák 9612 (127)	Italy, Sardinia, Genargentu Mts	1450	9,292222222	40,0775	shrubs
xerothermica	Jiří Malíček 7063	Italy, Piemonte	920	7,55	44,21666667	young Quercus petraea
xerothermica	Jiří Malíček 7071	France, Alpes Maritimes Mts, Tende	900	7,583333333	44,08333333	twigs of Prunus
xerothermica	Jiří Malíček 7082	France, Alpes Maritimes Mts, Tende	900	7,583333333	44,08333333	Fraxinus
xerothermica	PRA - Vondrák 3081	Greece, Orestiada, Soufli, Dadia	100	26,21666667	42,86666667	?
xerothermica	PRA - Vondrák 2214	Bulgaria, E Rhodopes, Haskovo	250	25,66666667	41,66666667	Pistacia terebrinthus
xerothermica	ERC - Halıcı CL836	Turkey, Antalya, Kemer, Beycik Village	850	30,65083333	36,675	Pinus brutia bark
xerothermica	C - Søchting 10523, CBFS	Spain, Madrid	650	-3,683333333	40,4	Pinus pinea twigs
xerothermica	C - Søchting 9664, 9991, CBFS	Spain, Zaorejas	1240	-2,2	40,73333333	Juniperus twigs
xerothermica	PRA - Vondrák 8655	Greece, Peloponnese, Kastri	700	22,56666667	37,36666667	Platanus
xerothermica	PRA - Vondrák 10826	Italy, Sardinia, Olbia, San Pantaleo	100	9,433333333	41,03333333	Phillyrea latifolia
xerothermica	C - Christensen 3733	Italy, Sardinia, Genargentu Mts	1300	9,292	40,077	Quercus pubescens
xerothermica	PRA - Vondrák 10748	Italy, Sicily, Taormina, Roccafiorita	900	15,26666667	37,93333333	twig
xerothermica	in Jiří Malíček 5605	Spain, Andalusia, Jimena de la Frontera	60	-5,466666667	36,43333333	twig of Olea europaea
xerothermica	GZU (Eitschberger 1976)	Greece, Athen- Pefki	260	23,8	38,06666667	Pinus halepensis
xerothermica	Claude Roux 26374, 26376	France, Var, Barjols	300	5,99777	43,56263	twigs of Olea europea
xerothermica	Claude Roux 26710	France, Vaucluse, Mirabeau	560	5,64794	43,68864	Pistacia terebinthus
xerothermica	Ivan Frolov 953	Italy, Sardinia, Olbia, San Pantaleo	100	9,4461111	41,035556	Mediterranean shrubs
xerothermica	C - Søchting 10025, CBFS	Spain, La Rioja	1150	-2,733333333	42,08333333	Crataegus
xerothermica	B 600190017 (coll. Sipman)	Greece, Pelopponese, Methana	640	23,371667	37,601667	Arbutus unedo
xerothermica	B 600192778, B 600162781 (coll. Sipman)	Greece, East Aegean Islands, Chios	690	26,036667	38,424333	twig of Pinus brutia
xerothermica	B 600194463 (coll. Sipman)	Greece, East Aegean Islands, Chios	880	26,009333	38,488333	twig of Juniperus oxycedrus
xerothermica	C - Christensen 3176	Greece, Crete, Chania	560	23,86585	35,416651	Castanea sativa
xerothermica	C - Christensen 13549	Spain, Madrid, La Pedriza de Manzanares	1138	-3,895773	40,738344	Quercus
xerothermica	SAV - Pišút A-929	Greece, Andros	300	24,89	37,81	Phillyrea latifolia

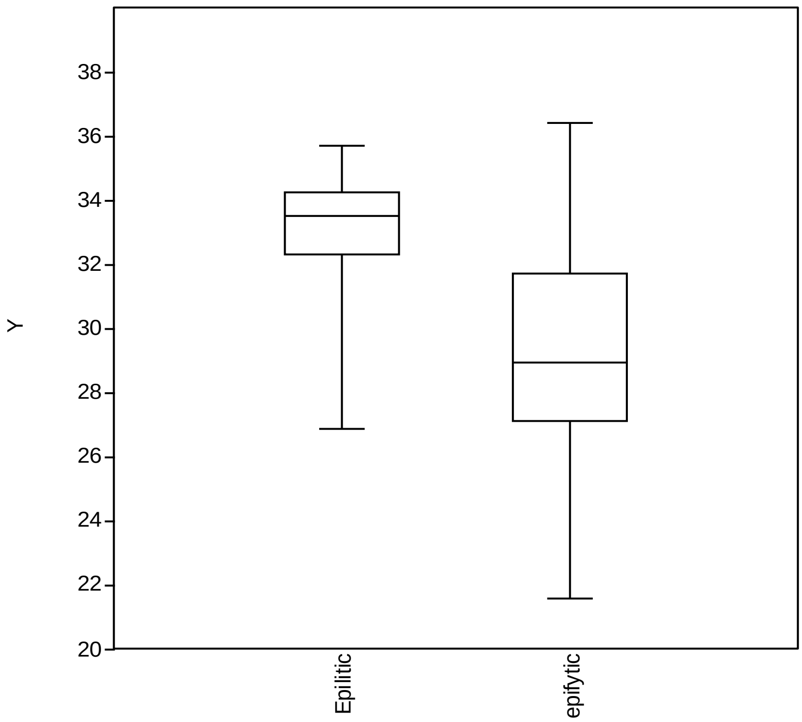
xerothermica	C - Christensen 5761	Greece, Peloponnese, Messinia, Kalamata	1250	22,098	37,074	trunk of Pinus nigra
xerothermica	GZU (Poelt et Clauzade, coll. 17.7.1970)	France, Vaucluse, Rustrel	380	5,481626	43,932167	bark and wood
xerothermica	Linda in Arcadia 22-Mar-00/L26H	Greece, Pelopponese, Keramidia	155	21,461282	37,856072	Pinus halepensis
xerothermica	Ivan Frolov 988	Spain, Andalusia, Cádiz, NP Grazalema	1200	-5,386483	36,738536	Prunus
xerothermica	Ivan Frolov 982	Spain, Andalusia, Cádiz, NP Grazalema	1200	-5,386483	36,738536	Pistacia terebinthus
xerothermica	Ivan Frolov 956	France, Alpes-de-Haute-Provence, Gorges Du Verdon	850	6,317	43,762913	Sorbus
xerothermica	Ivan Frolov 955	France, Alpes-de-Haute-Provence, Gorges Du Verdon	850	6,317	43,762913	Pistacia terebinthus
xerothermica	Ivan Frolov 998	Spain, Catalonia, Barcelona, outscirts of Santa Maria de Montserrat Abbey	1100	1,811417	41,605107	Quercus ilex
xerothermica	MA - Lichen14728	Spain, Ciudad Real, Sierra de San Andrés	900	-3,6	38,5	Quercus suber trunk
xerothermica	Ivan Frolov 1016	Spain, Andalusia, Cádiz, NP Grazalema	1000	-5,429	36,776009	Quercus ilex
xerothermica	Ivan Frolov 1043	Spain, Andalusia, Granada, NP Sieerra Nevada	1550	-3,350073	36,95187	Quercus ilex
xerothermica	Ivan Frolov 975	Spain, Andalusia, Cádiz, NP Grazalema	1200	-5,386483	36,738536	Pinus halepensis
xerothermica	Ivan Frolov 994	Spain, Andalusia, Cádiz, NP Los Alcornocales, Mt Picacho	600	-5,6355	36,518389	Olea
xerothermica	Ivan Frolov 974	Spain, Andalusia, Cádiz, NP Grazalema	1400	-5,386483	36,738536	Pinus pinaster
xerothermica	Ivan Frolov 1034	Spain, Andalusia, Granada, S foothills of Sieerra Nevada	1150	-3,184855	36,973917	Quercus ilex
xerothermica	Ivan Frolov 1020	Spain, Andalusia, Cádiz, 12 km NNE of Grazalema	720	-5,28191	36,774972	Quercus suber
xerothermica	Ivan Frolov 954	France, Alpes-de-Haute-Provence, Gorges Du Verdon	850	6,317	43,762913	Buxus sempervirens
xerothermica	Ivan Frolov 1009	Spain, Extremadura, Cáceres, NP Monfragüe	400	-6,045694	39,827405	Quercus ilex
xerothermica	Ivan Frolov 958	France, Alpes-de-Haute-Provence, Gorges Du Verdon	850	6,317	43,762913	Amelanchier ovalis
xerothermica	Ivan Frolov 1014	Spain, Andalusia, Cádiz, c. 1.2 km SW of Grazalema	1240	-5,3826	36,754594	Quercus ilex
xerothermica	Ivan Frolov 957	France, Alpes-de-Haute-Provence, Gorges Du Verdon	850	6,317	43,762913	Acer monspessulanum
xerothermica	Ivan Frolov 984	Spain, Andalusia, Cádiz, NP Grazalema	1200	-5,386483	36,738536	Quercus ilex
xerothermica	Ivan Frolov 1012	Spain, Extremadura, Cáceres	400	-6,027139	39,6864	Quercus ilex
xerothermica	Ivan Frolov 962	France, Alpes-de-Haute-Provence, Gorges Du Verdon	850	6,317	43,762913	Pistacia terebinthus
xerothermica	Ivan Frolov 997	Spain, Andalusia, Cádiz, NP Los Alcornocales	600	-5,6355	36,518389	Quercus suber
xerothermica	Ivan Frolov 1031	Spain, Extremadura, Cáceres, NP Monfragüe	400	-6,045694	39,827405	Olea
xerothermica	MA - Lichen7685 (coll. Aragón et al.)	Spain, Caceres, Hoyos	550	-6,7	40,2	Olea europea
xerothermica	PRA - Vondrák 15100	France, Vaucluse	462	5,48632	43,9267	Pistacia
xerothermica	PRA - Vondrák 15103	France, Vaucluse	462	5,48632	43,9267	Juniperus phoenicea
xerothermica	PRA - Vondrák 15126	France, Vaucluse	730	5,42088	44,13303	Prunus mahaleb

xerothermica	PRA - Vondrák 17872	Spain, Madrid, Tablada	1530	-4,14233	40,70266	twig of Pinus sylvestris
xerothermica	PRA - Vondrák 17880	Spain, Ronda, Sierra de las Nieves	1300	-5,042	36,693	twig of Crataegus
xerothermica	PRA - Vondrák 17881	Spain, Castilla y León, Tiedra, Villardefrades	900	-5,21814	41,69291	bark of Quercus illex
xerothermica	PRA - Vondrák 17896	Spain, Castilla y León, Astorga	1020	-6,12629	42,48926	twigs of Quercus ilex
xerothermica	PRA - Vondrák 17897	Spain, Cuidad Real, Brazatortas, La Garganta	950	-4,3853	38,5349	twigs of Phillyrea angustifolia
xerothermica	Ivan Frolov 1621	Greece, NP Vikos-Aoös	600	20,688396	39,948243	on Ostrya carpinifolia
xerothermica	Ivan Frolov 1616	Albania, NP Llogara	1000	19,591447	40,198702	on Quercus coccifera
xerothermica ?	GZU (Pongratz 1987)	Croatia, Velebit Mts, Lopči	500	15,41666667	44,55	Quercus pubescens
xerothermica ?	C - Christensen 5659, 5662, 5670, 5673	Greece, Mt Olympus	1600	22,472822	40,066224	trunk, branch of Pinus heldreichii
xerothermica ?	C - Christensen 4341, 4329, 4332, 4335, 4337, 4339, 4326, 4342	Greece, Samarina, Mt Smolikas	1320	21,017846	40,089722	trunk of Pinus nigra
xerothermica ?	C - Christensen 4319, 4320	Greece, Samarina, Mt Smolikas	1320	21,017846	40,089722	twig of Pinus heldreichii
xerothermica ?	C - Christensen 6012	Greece, Mt Vourinos	1300	21,672641	40,174157	dead Juniperus oxycedrus
xerothermica ?	C - Christensen 4285	Greece, Samarina	1320	21,137803	40,085257	dead Pinus nigra
xerothermica ?	C - Christensen 9013	Greece, Mt Vourinos	900	21,672	40,174	Buxus
xerothermica ?	C - Christensen 5886	Greece, Ioannina, Milea, Mt Maurovouni	1450	21,208646	39,86668	trunk of Pinus heldreichii
xerothermica ?	C - Christensen 5912	Greece, Ioannina, Milea, Mt Maurovouni	1450	21,208646	39,86668	trunk of Pinus nigra
xerothermica ?	C - Christensen 9197, 9212	Greece, Ioannina, Konitsas, Mt. Trapezitsa	900	20,772534	40,056785	trunk of Pinus nigra
xerothermica ?	C - Christensen 5674, 5675	Greece, Mt Olympus	1475	22,472822	40,066224	trunk of Pinus heldreichii
xerothermica ?	C - Christensen 8922	Greece, Mt Olympus	2200	22,367	40,082	branch of Pinus heldrechii
xerothermica ?	C - Christensen 9001	Greece, Mt Olympus	2275	23,367	41,082	branch of Pinus heldrechii
xerothermica ?	Ivan Frolov 1395	France, Massif Central, Hérault department, Saint-Maurice-Navacelles	600	3,505508	43,888569	bark of Acer monspessulanum
xerothermica ?	Ivan Frolov 1375, 1378	France, Massif Central, Aveyron department, Millau	700	3,202347	44,136039	bark of Sorbus aria
xerothermica ?	Ivan Frolov 1632	Greece, Konitsa, Pades	1200	20,905319	40,036809	on Ostrya carpinifolia

Supplementary table 2. Results of flow cytometry measurements. Red data are not reliable, from specimens collected before 2009. Reliability of green data (specimens from 2010–2012) is not certain. Means from three measurements of genome size are highlighted. Substrate: I, inorganic; O, organic. Box and whisker plot below the table shows differences in genome size between epiphytic and epilithic specimens (green and red data are not included).

Species / specimen (herbarium)	Group	Substrate	Year of collection	Genome size				Coefficient of variation (CV)			
				mes. 1	mes. 2	mes. 3	mean	CV 1	CV 2	CV 3	mean
afroalpina / Miehe U09-10701 (GZU)	Herbidella	O	1997	20,0	21,4	22,5	21,3	11,3	12,7	11,1	11,7
ammiospila / Urbanavichus PAZ150801 (PRA)	Psychrophila	O	2015	27,4	26,2	27,7	27,1	9,1	10,4	10,0	9,8
anatolica / Frolov 675 (Frolov)	Psychrophila	O	2014	32,8	31,5	31,1	31,8	11,9	6,1	11,1	9,7
catalinae / Frolov 1238 (Frolov)	Crenularia	O	2015	27,2	30,0	29,6	28,9	7,9	10,4	12,4	10,2
caucasica / Frolov 670	Psychrophila	I	2014	28,8	29,3	29,9	29,3	6,7	5,0	4,9	5,5
coralliza / Vondrák 10876 (PRA)	Herbidella	O	2012	27,2	26,7	26,5	26,8	9,1	10,9	13,2	11,1
crenularia (Island) / Søchting 7523 (C)	Crenularia	I	1990	22,7	23,2	23,2	23,0	9,2	14,1	9,3	10,9
crenularia / Vondrák 5608 (PRA)	Crenularia	I	2007	32,8	33,8	33,8	33,5	8,8	6,7	6,6	7,4
crenularia / Vondrák 8785 (PRA)	Crenularia	I	2010		32,7	34,6	33,7		9,1	9,6	9,4
crenularia / Frolov 944 (Frolov)	Crenularia	I	2012	32,8	33,3	32,1	32,7	7,5	6,8	6,2	6,8
crenularia / Vondrák 17865 (PRA)	Crenularia	I	2017	29,3	30,3	31,6	30,4	9,8	9,2	8,1	9,0
crenularia / Vondrák 17877 (PRA)	Crenularia	I	2017	30,5	32,9	30,2	31,2	8,9	9,9	8,6	9,1
crenularia / Vondrák 17869 (PRA)	Crenularia	I	2017	28,8	29,8	28,1	28,9	8,9	9,2	11,4	9,8
crenularia / Vondrák 17875 (PRA)	Crenularia	I	2017	29,4	31,1	31,8	30,8	9,6	9,0	7,6	8,7
crenularia / Vondrák 17898 (PRA)	Crenularia	I	2017	28,6	29,2	27,9	28,6	10,3	7,5	6,2	8,0
crenularia / Malíček 7423 (Malíček)	Crenularia	I	2014	35,6	34,3	34,8	34,9	7,1	8,2	8,5	7,9
crenularia / Vondrák 12590 (PRA)	Crenularia	I	2014	33,8	33,1	35,1	34,0	6,5	7,3	8,0	7,3
crenularia / Vondrák 12575 (PRA)	Crenularia	I	2014	31,7	32,2	33,0	32,3	7,0	7,2	7,2	7,1
crenularia / Vondrák 13100 (PRA)	Crenularia	I	2015	34,4	35,7	37,0	35,7	7,5	7,1	11,3	8,6
crenularia / Vondrák 17837 (PRA)	Crenularia	I	2013	36,1	35,2	34,4	35,2	6,2	6,2	6,9	6,4
croatica / Frolov 966 (Frolov)	Herbidella	O	2015	30,0	32,7	32,4	31,7	7,2	8,9	8,0	8,0
disjuncta / Vondrák 17886 (PRA)	Disjuncta	O	2017	30,5	30,3	30,6	30,5	9,1	6,5	7,0	7,5
ferruginea / Vondrák 13109 (PRA)	Herbidella	O	2015	27,7	28,6	29,8	28,7	7,7	7,9	9,1	8,2
festivella (corticolous) / Vondrák: Cal,Exs, 37 (PRA)	Festivella	O	2008	27,3	28,8	28,7	28,3	12,1	15,7	6,1	11,3
festivella (corticolous) / Vondrák 17856 (PRA)	Festivella	O	2017	31,0	33,7	31,7	32,1	7,8	10,8	7,0	8,5
festivella / Vondrák 17883	Festivella	I	2017	28,8	29,6	32,0	30,1	8,9	9,0	7,9	8,6
festivella / Frolov 1045 (Frolov)	Festivella	I	2015	35,4	34,0	34,1	34,5	6,0	7,2	6,0	6,4
festivella / Vondrák 12647 (PRA)	Festivella	I	2013	34,1	32,9	33,5	33,5	5,9	7,7	9,7	7,8
festivella / Vondrák 13098 (PRA)	Festivella	I	2015	31,5	32,1	33,8	32,5	8,7	6,5	7,4	7,5
festivella / Vondrák 13112 (PRA)	Festivella	I	2015	33,7	34,1	33,3	33,7	9,3	6,5	6,2	7,3
festivella / Vondrák 13114 (PRA)	Festivella	I	2015	31,6	31,7	33,6	32,3	6,5	8,5	6,1	7,0
furfuracea / Davydov 10713 (ALTB)	Psychrophila	O	2011	26,1	28,3	27,6	27,3	8,7	10,6	10,0	9,8
gennargentuae / Vondrák 9609 (PRA)	Festivella	I	2012	30,8	30,6	30,3	30,6	5,9	8,3	6,6	6,9
herbidella subsp, acidophila / Urbanavichene s,n, (PRA)	Herbidella	O	2009	22,6	26,0	24,3	24,3	13,4	12,7	8,5	11,5
herbidella subsp, herbidella / Vondrák 11335 (PRA)	Herbidella	O	2013	28,5	31,4	30,8	30,2	10,0	8,5	5,3	7,9
hungarica / Palice 18699 (PRA)	Hungarica	O	2015	27,1	29,1	28,5	28,2	10,2	9,8	6,5	8,8
monticola / Urbanavichus LK01 (PRA)	Psychrophila	O	2015	29,2	30,5	29,7	29,8	7,4	9,5	8,5	8,5

palmae / Frolov 1007 (Frolov)	Hungarica	O	2015	29,7	28,4	31,6	29,9	6,2	8,9	6,1	7,1
psychrophila / Vondrák 11852 (PRA)	Psychrophila	I	2011	27,5	26,3	26,8	26,9	9,0	11,5	10,9	10,5
purpurea / Vondrák 12629 (PRA)	Crenularia	I	2014	34,3	34,3	34,1	34,2	7,0	8,0	8,5	7,8
scabrosa / Vondrák 13628 (PRA)	Psychrophila	I	2015	32,6	33,1	32,0	32,5	5,6	5,7	5,2	5,5
subathallina / Vondrák 12105 (PRA)	Hungarica	O	2014	23,3	21,3	20,1	21,6	9,5	13,9	11,9	11,8
subathallina / Vondrák 13107 (PRA)	Hungarica	O	2015	24,7	26,6	26,5	25,9	8,8	8,6	9,7	9,0
xerothermica subsp, macaronesica / Vondrák 12111 (PRA)	Hungarica	O	2014	32,1	31,9	32,4	32,1	8,1	5,7	5,6	6,5
xerothermica subsp, xerothermica / Frolov 1033 (Frolov)	Hungarica	O	2015	35,4	36,8	37,0	36,4	10,1	11,0	7,7	9,6



Supplementary table 3. Secondary metabolites revealed by mass spectrometry in the negative electrospray ionization (ESI). Substance amounts calculated as the ratio of monoisotope mass (expressed by heights of peaks) to the most dominant compound. M, the most dominant compound; m, major compounds (10-100% of the the dominant coumpound); + -, minor compouds (1–10%); tr, trace amounts (<1%).

Species	**Sample**	**emodin**	**emodinal**	**parietin**	**citreorosein**	**fallacinal**	**emodic acid**	**teloschistin**	**7-Cl-emodin**	**parietinic acid**	**7-Cl-emodinal**	**fragilin**	**7-Cl-citreorosein**	**7-Cl-emodic acid**	**atranorin**
B. ammiospila	JV_N769	m	m	-	m	+	m	+	M	-	m	m	m	m	+
B. ammiospila	JV_F40	m	m	tr	m	+	m	tr	M	+	m	m	m	m	+
B. ammiospila	JV 3820	m	m	-	m	+	m	+	M	-	m	m	m	m	tr
B. ferruginea	JM 7591 dupl	m	m	+	+	tr	tr	-	M	m	m	m	m	m	tr
B. monticola	JV N765 dupl	m	m	tr	m	+	m	+	M	+	m	m	m	m	tr
B. palmae	JV 12106	M	m	+	m	-	m	-	m	m	tr	tr	tr	tr	-
B. purpurea	JV 12629	M	m	-	m	tr	m	tr	m	-	m	m	m	m	tr
B. subathallina	B 60 0192769	m	+	-	+	-	+	-	M	tr	m	-	m	m	tr