

Epiphytic leafy liverworts diversified in angiosperm-dominated forests

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Supplementary Information 1: Material and Methods

1.1 Analyses with R

The following analyses were performed with R¹ (<http://www.r-project.org/>).

1.1.1. General remarks

A dated phylogenetic framework was reconstructed by estimating simultaneously divergence time estimates and topology using a bayesian divergence time estimate approach as implemented in Beast 1.6.2. The analysed dataset comprised representatives of the leafy and simple thalloid liverworts (class Jungermanniopsida) plus a few representatives of the complex thalloid liverworts (class Marchantiopsida) utilized as outgroup taxa. A taxonomical overview of liverworts including thorough morphological discussion can be found in². The sampling was designed to obtain a proportional sampling of the two orders Jungermanniales and Porellales via random sampling within clades that are known to be phylogenetically robust. Except for 1.1.7 and 1.1.8, four independent analyses were run with the sampling corresponding to the hierarchical classification: the class Jungermanniopsida (simple thalloid and leafy liverworts), the subclass Jungermanniidae (leafy liverworts), as well as the orders Porellales (mainly epiphytic leafy liverworts) and Jungermanniales (mainly generalistic leafy liverworts). This was done to investigate whether the results for Jungermanniopsida (comprising all investigated taxa) were challenged if the subclades were analysed separately (subsampling effects). For analyses 1.1.2, 1.1.4, 1.1.6, 1.1.7, 1.1.8, and 1.1.9 the maximum credibility tree obtained from the Beast analyses was used. For analyses 1.1.3 and 1.1.5, 100 trees were selected randomly from the trees saved in the convergence phase of the Beast analysis used to estimate the maximum credibility tree. These analyses allowed us to explore the influence of phylogenetic uncertainty to our investigation. The assignments of the fossils are discussed in section 1.2.1.

1.1.2. Penalized Likelihood (Chronoplots with APE)

This method was applied to explore the substitution rate changes and the influence of the fossil assignments on our investigation. In particular, we investigated if the studied changes in the diversification rates show correlations with changes in the substitution rates. To visualize rate changes across the maximum credibility tree the penalized likelihood³ (PL) approach as implemented in the chronoplot function of APE⁴ (<http://cran.rproject.org/web/packages/ape/index.html>) was performed for Jungermanniopsida, Jungermanniidae, Jungermanniales and Porellales. To find the smallest smoothing parameter *lambda* that allows the maximal variation of the substitution rates in the subsequent PL, the cross-validation option was employed (values for the smoothing parameter *lambda* ranging from 10e-4 to 10e4). Nine values of *lambda* were sampled and plotted against the sum of the cross-validation values, then the analysis was performed with the smallest value for *lambda*⁵. The results for the cross-validation of the four clades are displayed in Supplementary 2.2. Figs 3-6 in Supplementary 2.2 show the rates plotted on the four clades of the maximum credibility tree from the Beast analysis.

1.1.3. Lineages through time plots with TreeSIM

To visualize the lineage diversification of the four clades (see 1.1.1) in time with confidence intervals, lineages through time plots (LTTP) were estimated with the R package TreeSIM⁶ (<http://cran.rproject.org/web/packages/TreeSim/index.html>) for 100 random trees from the convergence phase of the Beast analysis. These plots provide a visualisation of the accumulation of extant diversity through time (shown at the x-axis in million years towards the present (Ma)). The y-axis plotted in a logarithmic scale shows the proportion of lineages present at a given time interval. By doing so, we were able to integrate phylogenetic uncertainty (composed by topological uncertainty and variation of branch length estimates).

1.1.4. Gamma Statistics with APE and MCCR test with GEIGER

The gamma statistics of Pybus & Harvey⁷ is a constant rates (CR) test that evaluates the null hypothesis that speciation (λ) and extinction (μ) rates are constant through time using the internode intervals in a tree. Given a pure birth process (yule process) and a complete phylogeny the gamma values (γ) show a normal distribution with a mean zero and a standard deviation 1. The estimated γ shows to what extent a given phylogeny differs from this distribution. A negative γ ($\gamma < 0$) means that the cladogenic events are distributed more towards the root of the tree than can be expected under a pure birth model, indicating declining diversification rates. Positive

values ($\gamma > 0$) indicate a concentration of cladogenic events towards the tip nodes and therefore an acceleration of diversification. The null hypothesis of a constant rate is rejected when $\gamma < -1.645$ or $\gamma > 1.645$. γ was estimated with the “gammaStat” function of APE⁴ for the four clades of the maximum credibility tree (see 1.1.1). To account for the incompleteness of the phylogeny that may have biased the γ towards negative values, the null distribution of γ is estimated with the MCCR Test⁷. If the observed γ falls into the tail of this null distribution even with incomplete taxon sampling, there are more cladogenic events early or later in the history of the tree than expected under a constant rates model. The birth-death simulation with 500 replicates and random pruning was carried out with GEIGER⁸ (<http://cran.r-project.org/web/packages/geiger/index.html>) for the four clades recognised in the credibility tree (see above).

1.1.5. Estimation of diversification rate shifts with TreePAR

The R package TreePAR⁹ (<http://cran.r-project.org/web/packages/TreePar/index.html>) includes functions to estimate and visualize diversification rates shifts for a set of trees. The software was designed to identify evidence for changes in speciation (λ) and extinction (μ) rates as well as mass extinction events using not a single tree but evaluating the hypothesis across several trees generated for the same dataset. The function “bd.shifts.optim”, that estimates the maximum likelihood speciation and extinction rates as well as the rate shift times, was run with 100 random trees for the four clades (see 1.1.1). These analyses provide additional evidence for the detected rate changes under consideration of phylogenetic uncertainty measured using 100 randomly sampled trees (see above).

1.1.6. Modelfitting with LASER

To test which evolutionary model fits best to the branch times of the maximum credibility tree (see 1.1.1), we used the functions “fitdAICrc” and “yule-n-rate” implemented in LASER¹⁰ (<http://cran.r-project.org/web/packages/laser/index.html>). The fitdAICrc function fits a set of rate-variable and rate-constant models to the branching times and compares the AIC (Akaike Information Criterion) scores to find the best fitting models. The analysis was run for the following models: pure birth (yule), birth-death, DDL, and DDX. The “pureBirth” function models the speciation rate (λ) and the “bd” function additionally the extinction rate (μ); both are constant rate models. The diversity density dependent models DDX (taxa dependent) and DDL (rate dependent) were used beside the other models. The “yule-n-rate” function fits models with up to 5 rate changes under a pure birth model to a set of branching times and estimates the time of the rate change, again an AIC score is given. The four clades (see 1.1.1) were analysed separately. The resulting values for all models are displayed in the corresponding results sections. The best model (yule-5-rate) was chosen with the AIC and the times of rate changes were plotted on the lineages through time plots estimated with TreeSIM (see 1.1.3).

1.1.7. MEDUSA

With the “medusa” function of the R package GEIGER⁸ it is possible to estimate breakpoints in diversification by fitting diversification models (yule, birth-death, mixed) to a phylogeny. This approach allows to correct the impact of the incomplete sampling by considering the estimates of species diversity of terminal nodes. In this case, we used estimates for the species richness of each family of liverworts. To choose the best fitting model the AIC (Akaike Information Criterion) and the AICc (corrected Akaike Information Criterion) were employed. It was necessary to create a matrix of taxonomic richness containing the species numbers of genera or families as well as a reduced tree containing only one representative of the genus or family. With Mesquite¹¹ (<http://mesquiteproject.org>) the maximum credibility tree of Jungermanniopsida (see 1.1.1) was reduced to one species per family and a matrix with the species numbers per family was built. The following arguments were employed: AICc and AIC as criterions, “mixed” as model (considers yule and birth-death).

1.1.8. BiSSE with DIVERSITREE

To estimate if the characters “epiphytism” and “generalism” have a significant influence on the evolution of species, a BiSSE (binary state speciation and extinction)^{12,13} analysis was performed with the R package DIVERSITREE¹² (<http://cran.r-project.org/web/packages/diversitree/index.html>) for the maximum credibility tree and the clade Jungermanniopsida. The speciation rates (λ), extinction rates (μ) and character state transition rates (q) for epiphytes (E) and generalists (G) were estimated with the “make.bisse” function with maximum likelihood as well as bayesian inference under an exponential prior distribution^{13,14}. We explored in total seven models with one model having six (no constant rates), three models having five (one constant rate), and three models having four parameters (two constant rates). For each model, the likelihood values were used besides

AIC to rank the models hierarchically. Significance was tested using a chi-square test to estimate p-values. Particular care was given to observe the test statistics to identify conflicts. Character dependence of rate changes were also inferred using a sister comparison carried out by a Wilcoxon test. This analysis provided additional support to the hypothesis estimated independently from the BiSSE approach.

1.1.9. Estimation of speciation and extinction rates with DIVERSITREE

To explore the robustness of the test statistics, we employed the MCMC-based versions of BiSSE embedded in DIVERSITREE¹⁴. We calculated the distribution T null of each parameter set considered in the models above under a birth-death process. The constant rate function ("make.bd" function of DIVERSITREE) was employed when applicable. The obtained test statistics was used to explore the significance of the estimated model parameters in combination with the test statistics used to explore the best fitting models.

1.2. Fossil calibrations

1.2.1. General remarks

Fossils are assigned as most recent common ancestors (mrca) based on comparison with the extant liverwort diversity and phylogenetic evidence. Information on the morphology of the fossils was taken from the literature and/or based on the study of original material including types. In the framework of this study, we investigated some 200 amber inclusions of liverworts including specimens from the American Museum of Natural History in New York (USA), the National Museum of Natural History of the Smithsonian Institution in Washington DC (USA), the Natural History Museum London (UK), the Geoscientific Collections of the Georg August University Göttingen (Germany), the Geological-Palaeontological Collection of the University of Hamburg (Germany), the amber collection of the Museum of Natural History Berlin (Germany), the Stuttgart State Museum of Natural History (Germany), and the private collections of C. Groehn (Glinde, Germany), H. Grabenhorst (Wienhausen, Germany) and C. & H. W. Hoffeins (Hamburg, Germany). Fossils included in the analyses are listed in Supplementary 1.2.1 Table 1 and discussed in Supplementary 1.2.2. Intervals of the age of the fossils were taken from the most recent literature on the particular lagerstaetten. The youngest age was considered as minimum age constraint as recommended by several authors¹⁵⁻¹⁸ whereas the maximum age of 475 Ma for the root of the liverwort tree was employed as the maximum age constraint. This estimate is based on the age of the oldest known land plant fragments, Cambrian cryptospores¹⁹, some of which show similarities with the spores of certain extant liverworts²⁰.

Supplementary 1.2.1 Table 1: Fossils employed as minimum age constraints. The red letters in the first column refer to the chronogram for Jungermanniopsida (Supplementary 2.1 Fig.1).

	Age assignments	Taxon and reference	Origin and age of fossils
A	uniform: 385.3 – 475 Ma	<i>Metzgeriothallus sharonae</i> VanAller Hernick et al. ²¹	USA: 385.3-391.8 Ma
B	uniform: 35.0 - 385.3 Ma	<i>Ptilidium</i> spec. ^{22, 23}	Baltic amber: 35-55 Ma
C	uniform: 35.0 - 385.3 Ma	<i>Porella subgrandiloba</i> Grolle & M.L.So ²⁴	Baltic amber: 35-55 Ma
D	uniform: 35.0 - 385.3 Ma	<i>Radula sphaerocarpoides</i> Grolle ²⁵	Baltic amber: 35-55 Ma Bitterfeld amber: ~23 Ma
		<i>Radula oblongifolia</i> Casp. ²⁶	Baltic amber: 35-55 Ma Bitterfeld amber: ~23 Ma
E	uniform: 99.6 - 385.3 Ma	<i>Frullania cretacea</i> Hentschel et al. ²⁷	Burmese amber: 99.6-112 Ma
F	uniform: 35.0 - 385.3 Ma	<i>Nipponolejeunea europaea</i> Grolle ²⁸	Baltic amber: 35-55 Ma Bitterfeld amber: ~23Ma
G	uniform: 35.0 - 385.3 Ma	<i>Cheilolejeunea latiloba</i> (Casp.) Grolle ²⁹	Baltic amber: 35-55 Ma Bitterfeld amber: ~23Ma
H	uniform: 15.0 - 385.3 Ma	<i>Marchesinia pusilla</i> Gradst. ³⁰	Dominican amber: 15-20 Ma
I	uniform: 35.0 - 385.3 Ma	<i>Spruceanthus polonicus</i> Grolle ³¹	Baltic amber: 35-55 Ma
J	uniform: 15.0 - 385.3 Ma	<i>Lopholejeunea subnigricans</i> Gradst. ³⁰	Dominican amber: 15-20 Ma
K	uniform: 15.0 - 385.3 Ma	<i>Ceratolejeunea</i> spec. ³⁰	Dominican amber: 15-20 Ma
L	uniform: 15.0 - 385.3 Ma	<i>Lejeunea</i> spec. ³²	Dominican amber : 15-20 Ma
M	uniform: 15.0 - 385.3 Ma	<i>Cololejeunea</i> spec. ³³	Dominican amber: 15-20 Ma
N	uniform: 35.0 - 385.3 Ma	<i>Bazzania polyodus</i> (Casp.) Grolle ³⁴	Baltic amber: 35-55 Ma
O	uniform: 35.0 - 385.3 Ma	<i>Plagiochila groehnii</i> Grolle & Heinrichs ³⁵	Baltic amber: 35-55 Ma
P	uniform: 35.0 -	<i>Calypogeia stenzeliana</i> Grolle ^{23,36}	Baltic amber: 35-55

	385.3 Ma		Ma Bitterfeld amber: ~23Ma
Q	uniform: 35.0 - 385.3 Ma	<i>Cylindrocolea dimorpha</i> (Casp.) Grolle ²³	Baltic amber: 35-55 Ma Bitterfeld amber: ~23Ma
R	uniform: 35.0 - 385.3 Ma	<i>Lophozia kutscheri</i> Grolle ^{23,37}	Baltic amber: 35-55 Ma Bitterfeld amber: ~23Ma
S	uniform: 35.0 - 385.3 Ma	<i>Scapania hoffeinsiana</i> Grolle ^{38,39}	Baltic amber: 35-55 Ma Bitterfeld amber: ~23Ma

1.2.2. Discussion of fossil assignments:

1.2.2.1. Sedimentary fossil:

Metzgeriothallus sharonae:

Fossil plant fragments from the Givetian (upper Middle Devonian) of New York consisting of furcated thalli with unistratose wings and a multistratose costa were described as *Metzgeriothallus sharonae* and assigned to the extant Metzgeriales²¹. Similar morphotypes occur not only in Metzgeriales but in several independent lineages of Jungermanniopsida, namely Metzgeriidae and Pelliidae². Accordingly, we abstain from accepting *Metzgeriothallus* as a member of Metzgeriales but instead treat it as mrca of Jungermanniopsida (simple thallose and derived leafy liverworts).

1.2.2.2. Amber fossils:

A. Burmese amber

Based on biostratigraphic work^{40,41,42} Burmese amber is of mid Cretaceous origin (~ Cenomanian); therefore 99.6 Ma was employed as minimum age.

Frullania cretacea: The cosmopolitan genus *Frullania* is represented in numerous Cenozoic amber inclusions, and also present in mid Cretaceous Burmese amber (for review see⁴³). It is characterized by reddish gametophytes with incubously-inserted, complicate bilobed leaves with the ventral lobe often forming a watersac. Several Burmese amber inclusions have been assigned to the extinct *F. cretacea*; a single gametophyte fragment from the same deposit has been described as *F. baerlocheri*. Since these fossils match the morphology of the *Frullania* crown group, they were treated as their mrca.

B. Baltic and Bitterfeld amber

The age of the Eocene Baltic amber is estimated as 35-55 Ma^{44,45}. It is a very prominent source of fossil liverworts²³. Numerous morphological details of these inclusions are preserved allowing for reliable assignments of the related species to extant genera. The Bitterfeld amber is of Oligocene origin and ca. 23 Ma old^{46,47,48}, and includes a liverwort diversity that is comparable to that of Baltic amber.

B.1. Porellales

Ptilidium spec.: A single fossil from Baltic amber was assigned to the extant species *Ptilidium pulcherimum*²³. The deeply lobed leaves with long ciliate appendages are indicative of *Ptilidium*, but the extensive sequence similarities of the extant sister species *P. pulcherium* and *P. ciliare*^{22,49} as well as slight differences in leaf shape oppose this species assignment. Accordingly, the fossil was treated as *Ptilidium* spec. and assigned to the clade containing the genera *Ptilidium*, *Neotrichocolea* and *Trichocoleopsis*.

Porella subgrandiloba: This species is based on a fertile shoot fragment with incubously inserted, complicate bilobed, entire leaves with flat lobules and juvenile gynoecia, and resembles the extant species *Porella*

grandiloba and *P. obtusata*^{23,24}. Due to the similarities to extant species in leaf and underleaf morphology, it was assigned to the *Porella* crown group.

Radula oblongifolia and *Radula sphaerocarpoides* are represented in Baltic and Bitterfeld amber; both species clearly belong to *Radula* based on the presence of *Radula*-type branching, incubous, complicate bilobed leaves and the absence of amphigastria. *R. sphaerocarpoides* is known only in sterile condition whereas some specimens of *R. oblongifolia* include fertile material with sporophytes²³. The morphological overlap of both species with extant representatives of *Radula* allows for a crown group assignment. We abstain from an assignment to subclades of *Radula* because of the morphologically diffuse nature of these clades⁵⁰.

Nipponolejeunea europaea: Gametophytes of this genus occur frequently in Baltic and Bitterfeld amber. A Baltic specimen was described as the extinct *Nipponolejeunea europaea*²⁸ and assigned to the extant *N. subalpina*²³. Heinrichs et al.²² doubted the conspecificity of the fossil *N. europaea* and the extant *N. subalpina* because of extensive sequence similarities of the two extant *Nipponolejeunea* species (*N. pilifera*, *N. subalpina*). Following the suggestions of⁵¹, the amber inclusions were thus treated as extinct species and assigned to a clade with *Nipponolejeunea* and its sister lineage *Jubula*.

Cheilolejeunea latiloba: Fertile amber inclusions of this species with intact gynoecia have been found in Baltic and Bitterfeld amber²³, supporting a treatment as mrca of the *Cheilolejeunea* crown group. The internal structure of *Cheilolejeunea* is not yet fully clarified and several genera are nested in it, e.g. *Aureolejeunea* and *Omphalanthus*⁵². This situation complicates a comparison of *Cheilolejeunea latiloba* with the extant diversity of Cheilolejeuneinae, and assignments to *Cheilolejeunea* subclades.

Spruceanthus polonicus: *Spruceanthus* is a small genus with three extant species in SE Asia and one in the Neotropics. A Baltic amber fossil with gynoecia matches the morphology of extant *Spruceanthus* and somewhat resembles the extant *S. semirepandus* from SE Asia²³. The extinct species *Spruceanthus polonicus* was placed on the split of *Spruceanthus* and *Ptychanthus*.

B.2 Jungermanniales

Bazzania polyodus: This species was recognized in Baltic and Bitterfeld amber and identified as a member of the extant genus *Bazzania*³⁴ based on the incubous leaf insertion, bifid leaves, and irregularly quadrilacinate underleaves. It is treated as mrca of *Bazzania* since its incomplete preservation hampers a comprehensive comparison to extant species.

Plagiochila groehnii: Two sterile shoot fragments from Baltic amber with alternating, toothed, wide spreading leaves are indicative of *Plagiochila* and resemble the extant *P. sciophila*³⁵. Since taxonomically relevant fertile structures and branches are unknown, the species was not assigned to a certain crown group lineage but treated as its mrca.

Calypogeia stenzeliana: This fossil species is known only in sterile condition and is characterized by incubous leaves, bilobed amphigastria and sometimes tapering shoot apices. The vegetative structures resemble those of the Holarctic *Calypogeia suecica*²³; lack of fertile structures and sporophytes only allow a treatment as the mrca of the *Calypogeia* crown group.

Cylindrocolea dimorpha: Several inclusions of ventrally branched, minute plants with succubously inserted, bilobed leaves in Baltic and Bitterfeld amber have been assigned to this morphologically variable, extinct species. The taxon was first assigned to *Cephaloziella*³⁴ but subsequently transferred to *Cylindrocolea* based on the lack of gemmae²³. Since *Cylindrocolea* is probably nested in *Cephaloziella*, the fossil taxon was treated as mrca of a well supported clade containing both genera.

Lophozia kutscheri: This fossil species is characterized by 2-3-lobed, transversely inserted leaves with gemmiferous apices. It was assigned to a widely circumscribed genus *Lophozia* including *Barbilophozia*, and compared to the extant *Barbilophozia hatcheri*²³. In recent years the genus *Barbilophozia* was separated from *Lophozia* based on molecular phylogenetic and morphological evidence⁵³; hence, *L. kutscheri* was assigned as mrca of this genus.

Scapania hoffsiana: This fossil representative of the extant genus *Scapania* was based on a liverwort inclusion with sharply complicate-bilobed, toothed leaves, eplicate perianth and 4-valved capsule in Bitterfeld

amber³⁸ and subsequently recognized in Baltic amber³⁹. The morphology of the fossil species indicates an affiliation to the extant subgenus *Scapania*^{51,54}; hence *S. hoffeinsiana* was treated as the mrca of this subgenus.

C. Dominican amber

Dominican amber is of early to middle Miocene origin (15-20 Ma)⁵⁵. It contains numerous inclusions of leafy liverworts, especially of the order Porellales³²:

Marchesinia pusilla: Two species of *Marchesinia* were recognized by Gradstein³⁰. One sterile inclusion was assigned to the extant *M. brachiata*, but the assignment needs verification according to⁵⁶. The extinct species *Marchesinia pusilla* was assigned to the split of *Marchesinia* and *Frullanoides*.

Lejeunea spec. A sterile specimen in Dominican amber with *Lejeunea*-type branching, two cells wide ventral merophytes, bifid underleaves as well as complicate bilobed leaves with rounded lobes and strongly inflated lobules fully matched the morphology of extant *Lejeunea*³². The generic affiliation of a second taxon in Miocene Mexican amber (*Lejeunea palaeomexicana*) has recently been questioned⁵⁷.

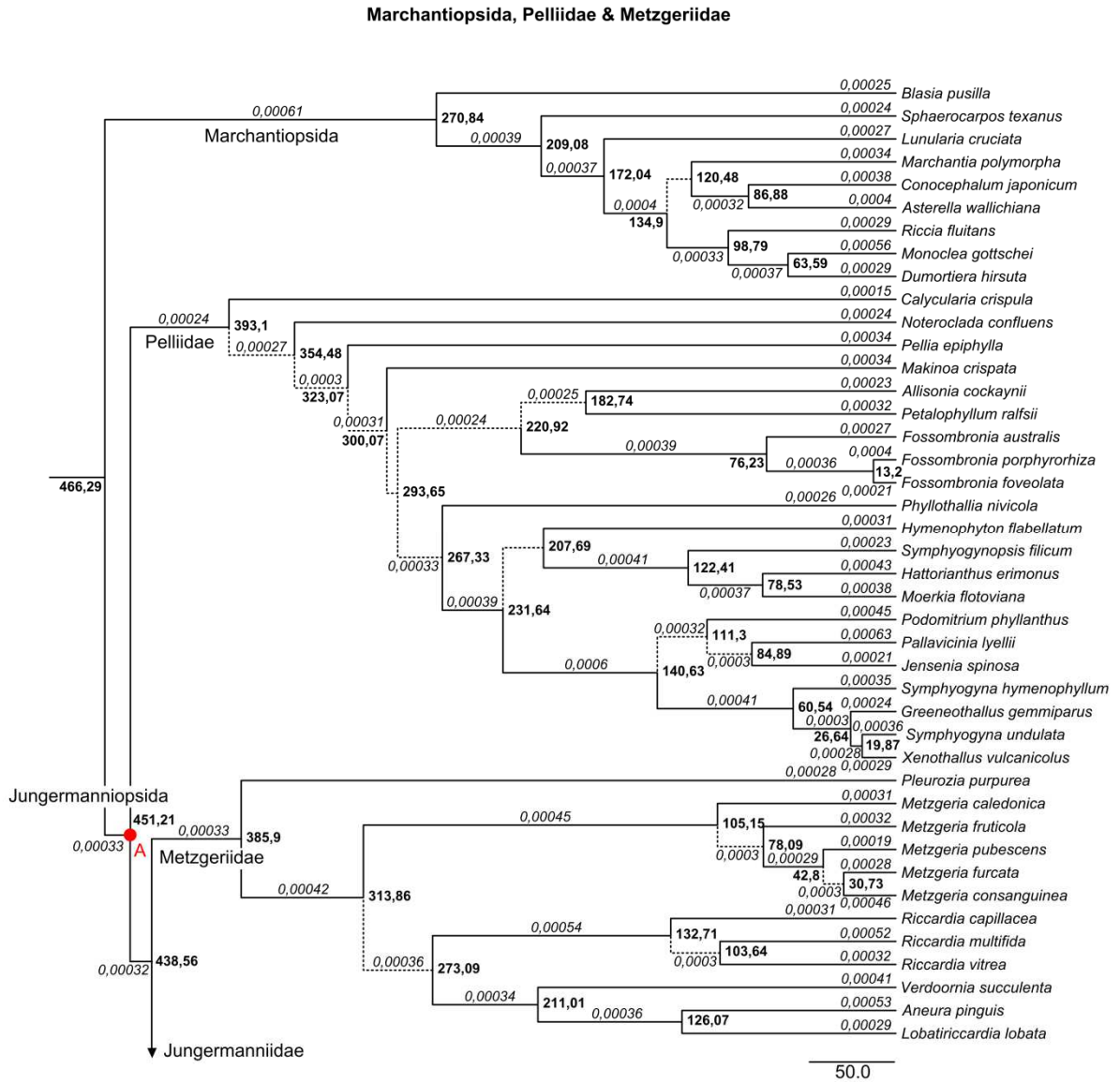
Lopholejeunea subnigricans: This Dominican amber fossil is known only in sterile condition. However, based on the undivided underleaves and the characteristic blackish color of the cell walls it could be assigned to *Lopholejeunea* without much doubt. It is morphologically similar to *L. nigricans*³⁰.

Ceratolejeunea spec.: The fossil is sterile and can be classified to genus level only. It shares some characteristics with the extant *C. plumula*, e.g. the toothed leaves³⁰.

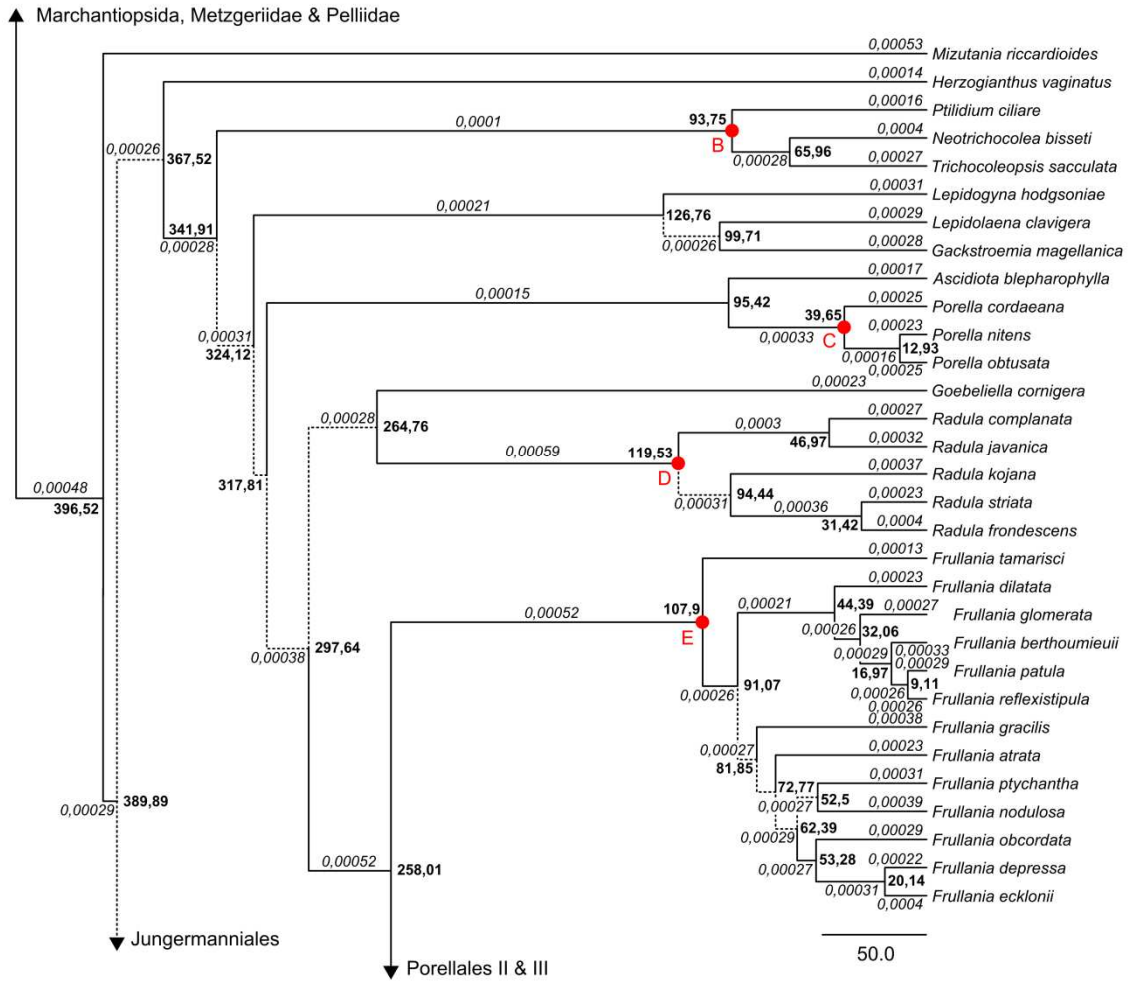
Cololejeunea spec.: This fossil is a syninclusion of the holotype of the lichen *Phyllopsora dominicanus*³³; the complicate-bilobed, incubously inserted leaves and lack of underleaves are indicative of *Cololejeunea*

Supplementary Information 2: Results

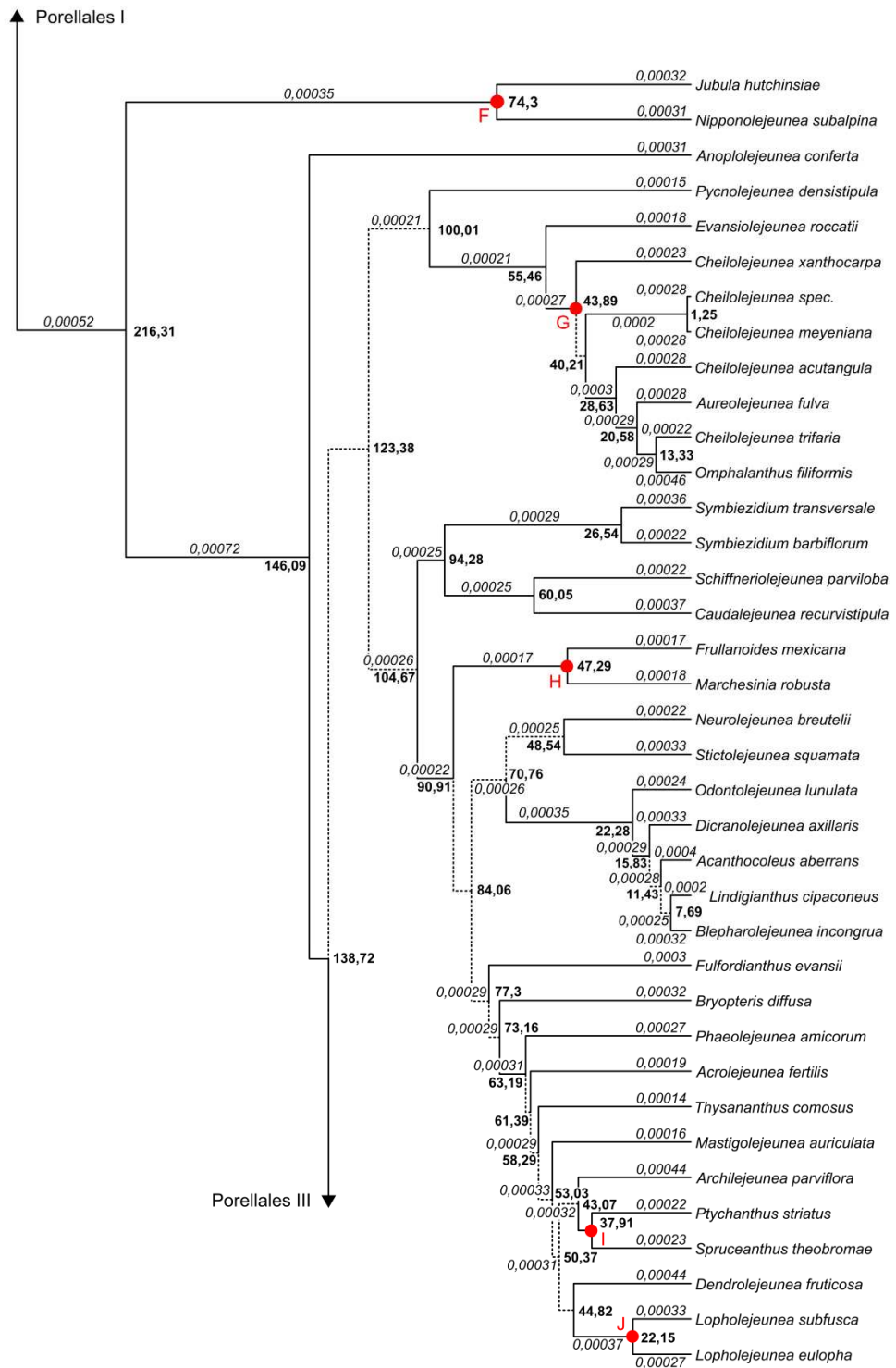
2.1. Chronogram for Jungermanniopsida (estimated with BEAST 1.6.2.)



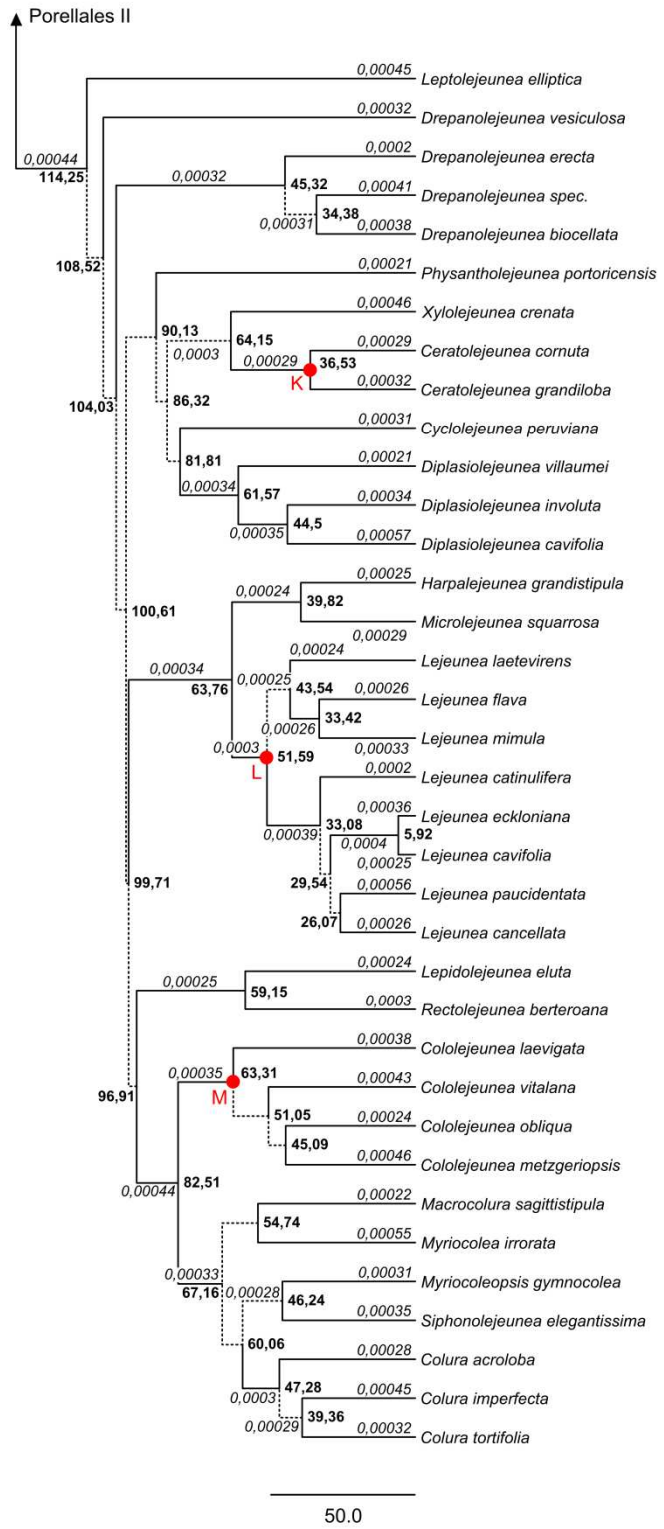
Porellales I

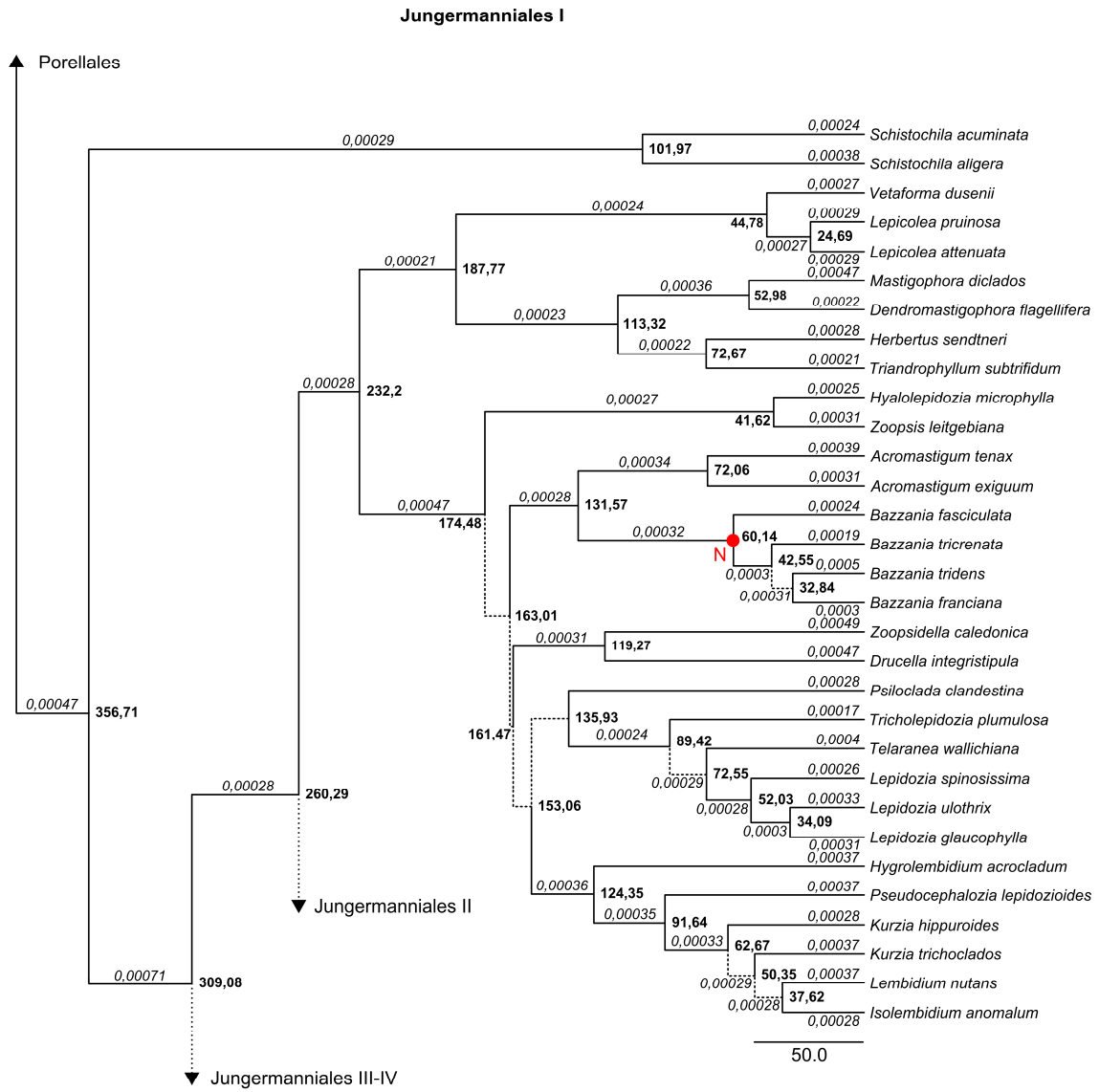


Porellales II

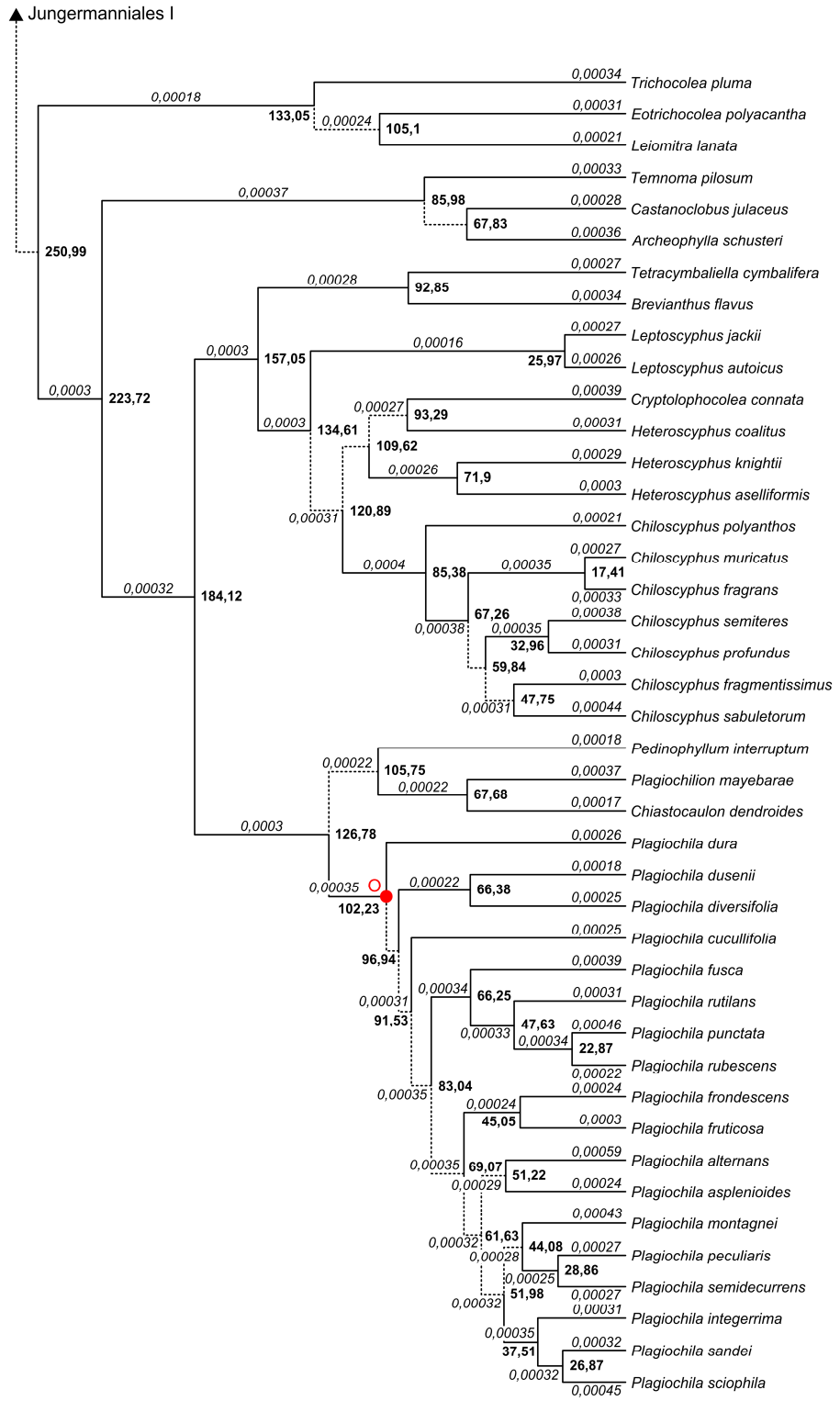


Porellales III



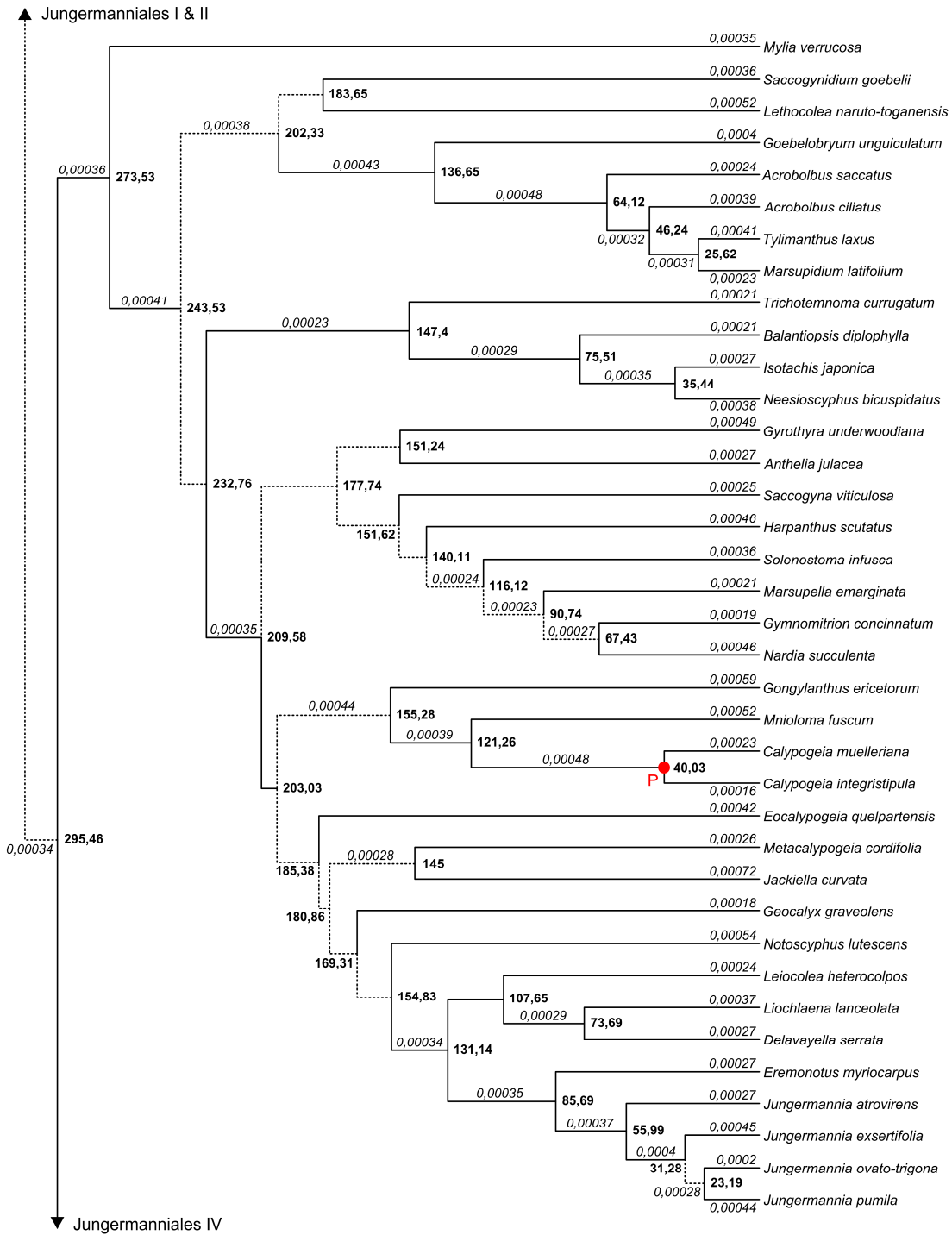


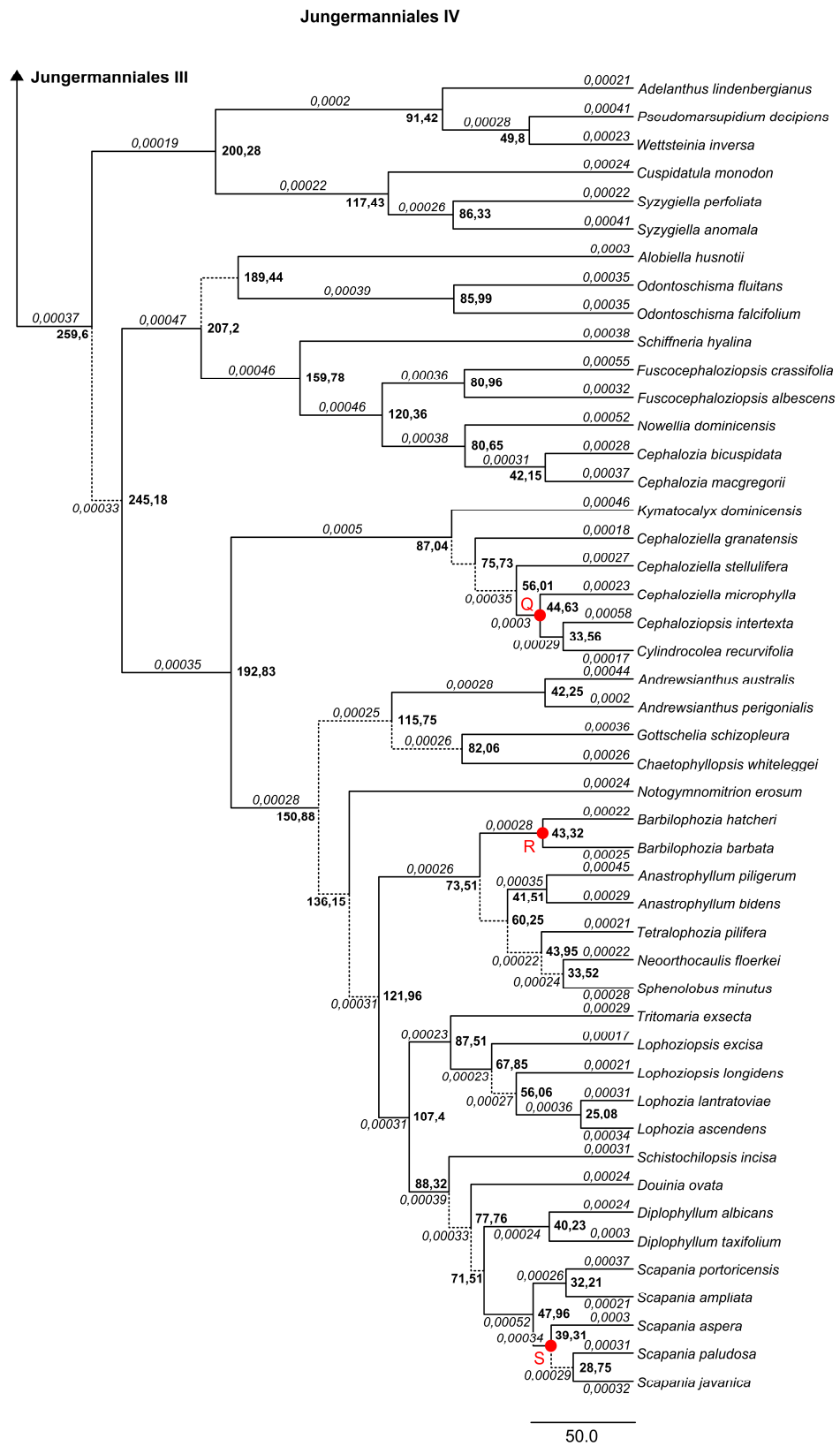
Jungermanniales II



50.0

Jungermanniales III





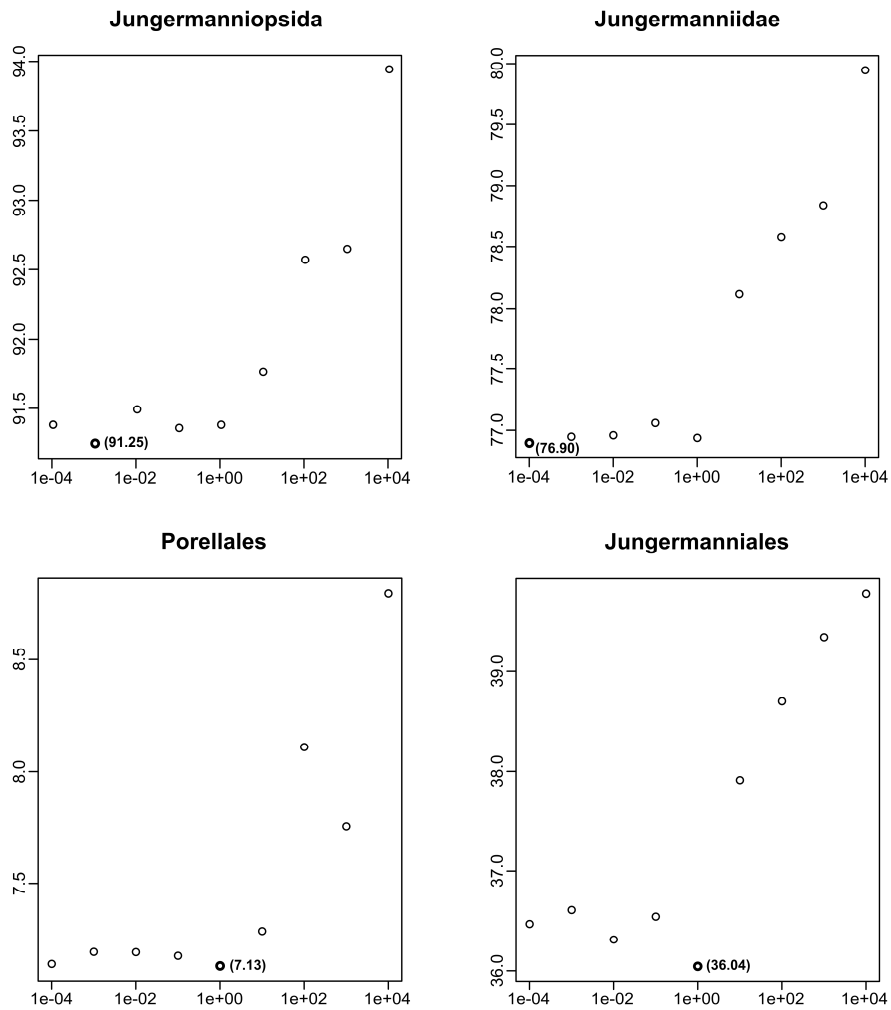
Supplementary 2.1. Fig. 1: Maximum credibility tree for Jungermanniales (estimated with Beast 1.6.2). Node ages (**bold**) and evolutionary rates (*italic*) are indicated. Branches with a posterior probability below 0.9 are indicated with dashed lines. Fossil calibrations are indicated as red dots with letters corresponding to Supplementary 1.2.1. Table 1. This is the chronogram as shown in Fig. 1.

2.2. Penalized Likelihood (Chronoplots with APE)

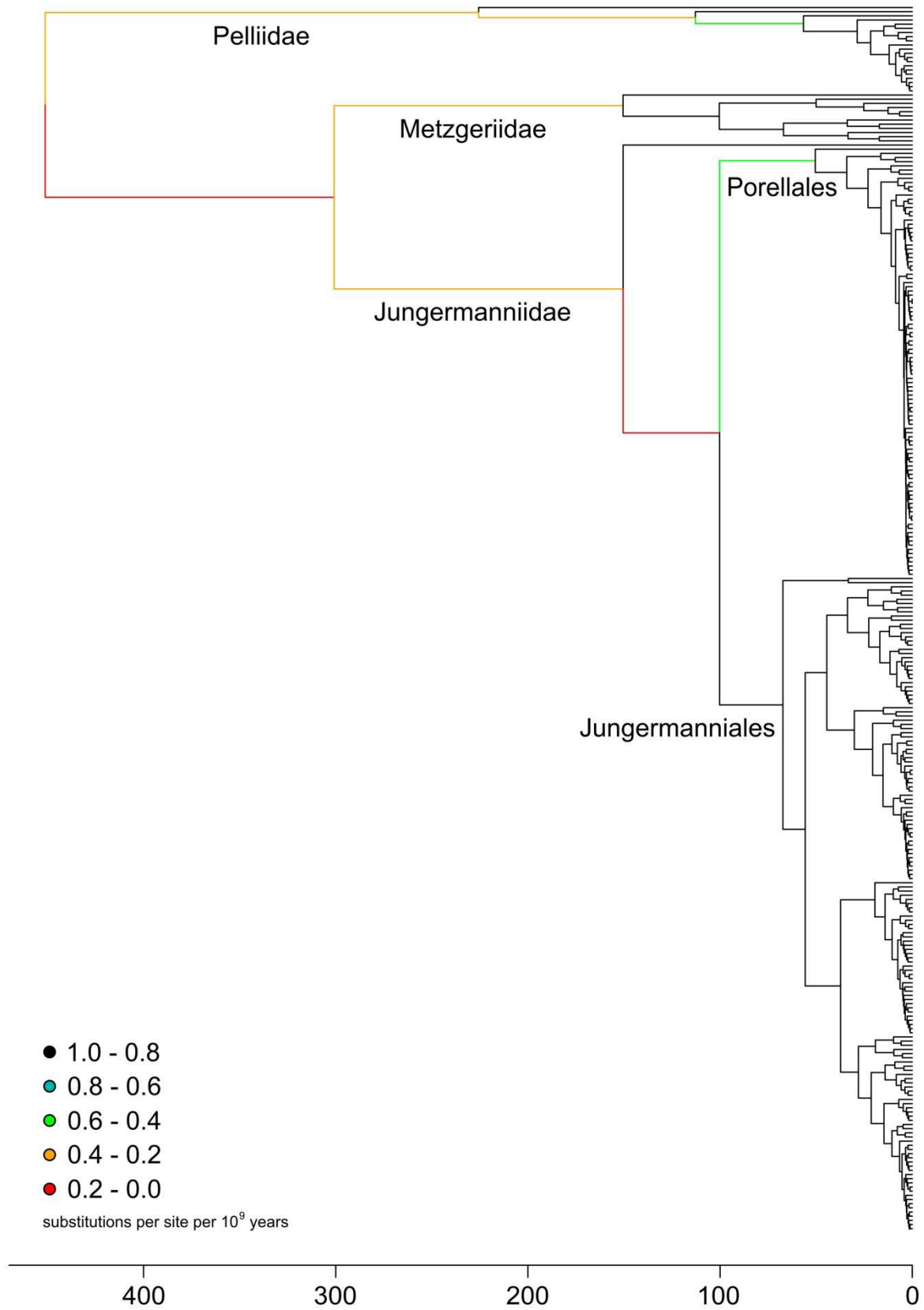
The mean substitution rates were estimated as relatively similar for all clades (Supplementary 2.2. Table 1), while the values for the minimum rates differ considerably, especially between Porellales and Jungermanniales, with the latter having much higher substitution rates. This is also apparent in the chronograms (Supplementary 2.2. Figs 2-5), with the colours corresponding to the substitution rates. There seem to be more rate changes within Porellales and some branches show very slow rates from 0.0-0.4 substitutions. Jungermanniales show mostly faster rates, with only few branches having a rate of 0.8-0.6. In summary, the results document the influence of the assigned fossil constrain and the absence of significant variation of substitution rates among the main clades of liverworts studied despite the lack of evidence for a constant molecular clock.

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
class Jungermanniopsida (simple thallose & leafy liverworts)	0.5792	1.0000	1.0000	0.9976	1.0000	1.0000
subclass Jungermanniidae (leafy liverworts)	0.1166	1.0000	1.0000	0.9787	1.0000	1.0000
order Porellales (mainly epiphytic liverworts)	0.1703	1.0000	1.0000	0.9671	1.0000	1.0000
order Jungermanniales (mainly generalistic liverworts)	0.6757	1.0000	1.0000	0.9860	1.0000	1.0000

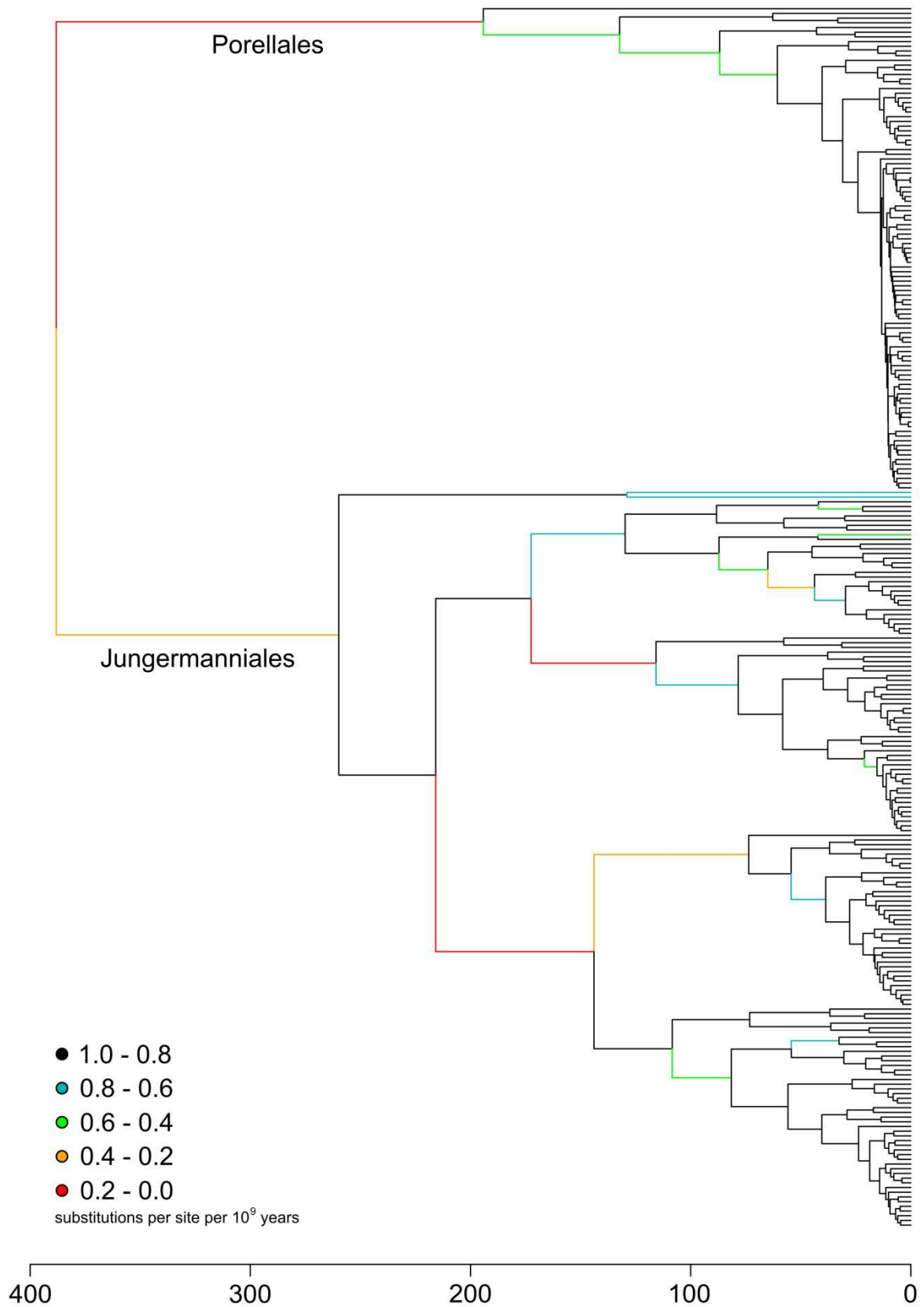
Supplementary 2.2. Table 1: Summary of the estimated rates. Rates are in units of substitutions per site per 10^9 years shown again using the hierachical classification with class, subclass and orders (see 1.1.1). No major effect was detected for the subsampling and no evidence was found for a significant difference of the substituton rates estimated for the two orders.



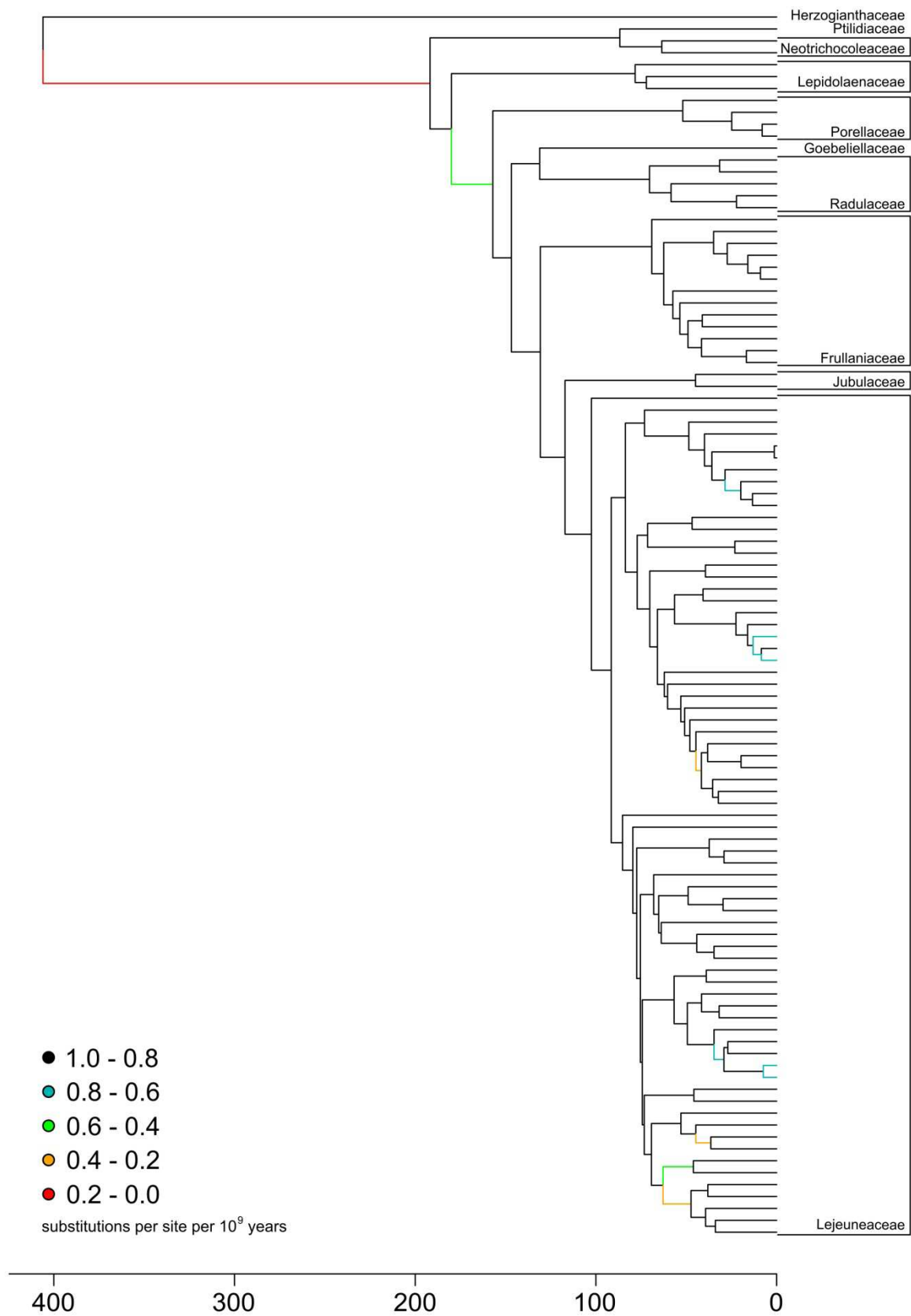
Supplementary 2.2. Fig. 1: Visualisation of the values of the cross-validation criterion (CV) plotted against the values of the smoothing parameter λ . The lowest values indicate low differences between the predicted and observed values and the results of these estimates were therefore used for plotting the substitution rates. Again, this is done for the four hierarchical taxonomic units explored (see 1.1.1).



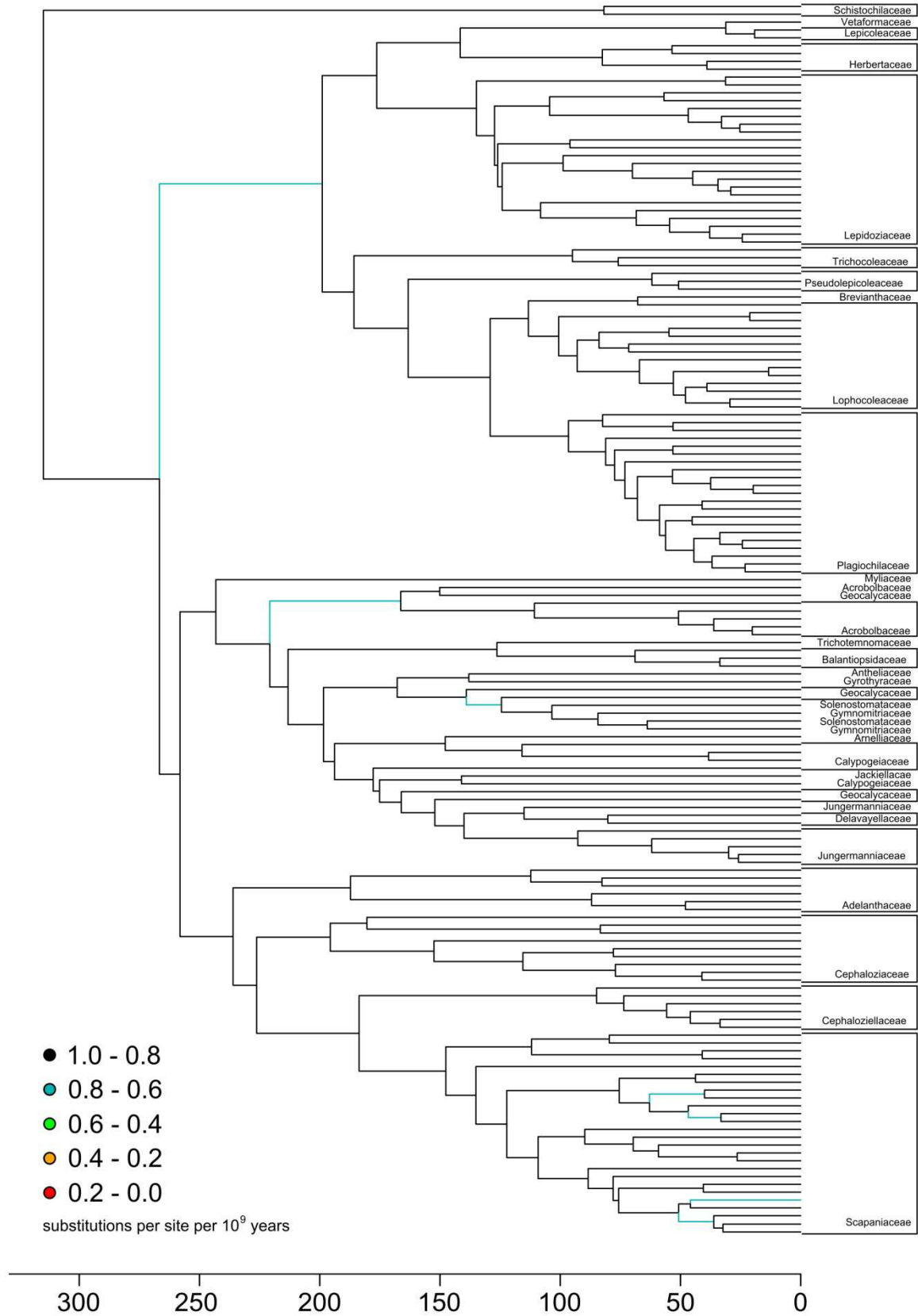
Supplementary 2.2. Fig. 2: Maximum credibility tree for Jungermanniopsida (leafy liverworts and simple thallose liverworts) estimated with Beast 1.6.2. Substitution rate estimates are plotted with the “chronoplots” function in APE (timescale in Ma).



Supplementary 2.2. Fig. 3: The Jungermanniidae (leafy liverworts) clade from the maximum credibility tree for Jungermannioptida estimated with Beast 1.6.2. Substitution rate estimates are plotted with the “chronoplott” function in APE (timescale in Ma).



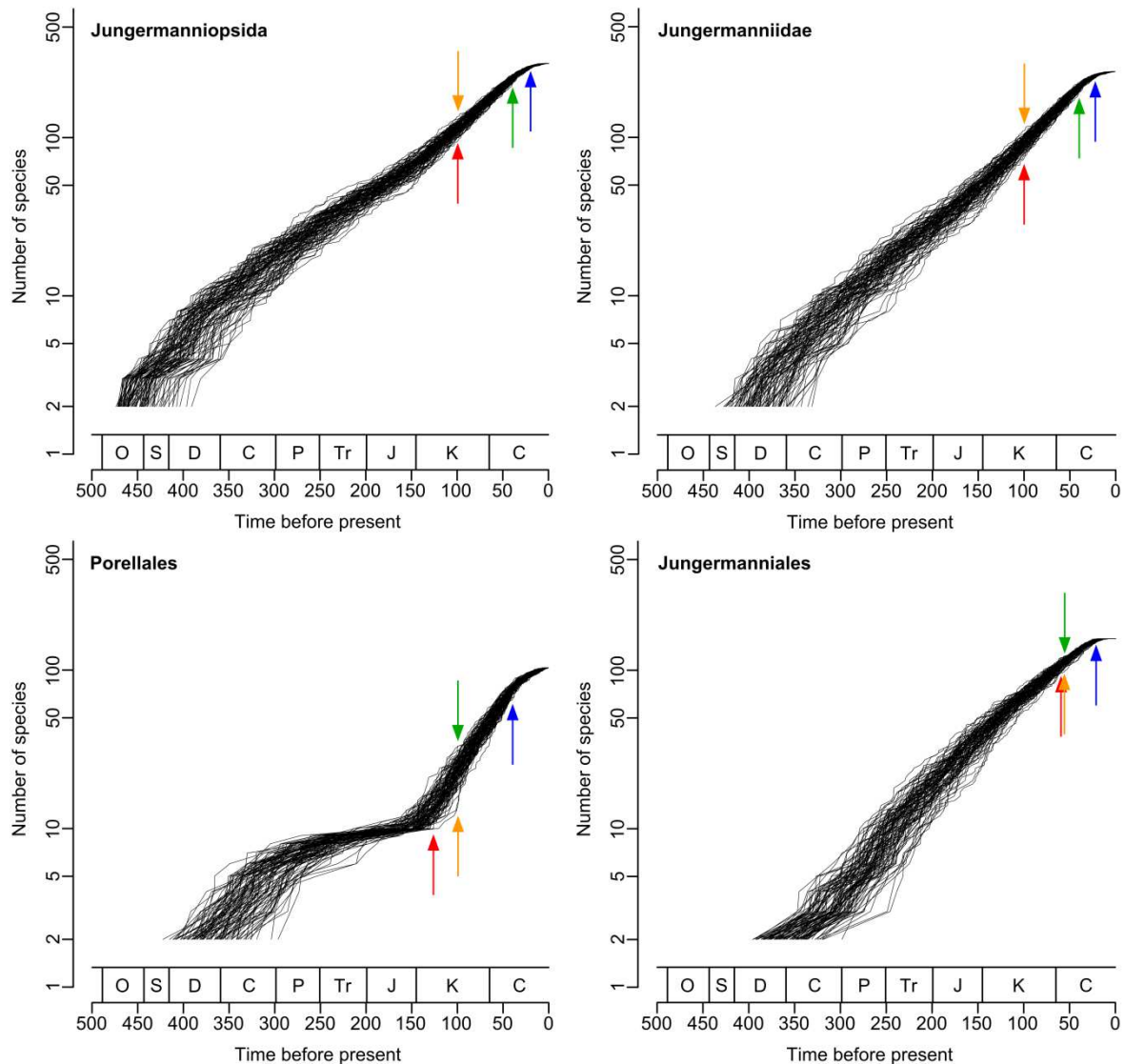
Supplementary 2.2. Fig. 4: The Porellales (mainly epiphytic leafy liverworts) clade from the maximum credibility tree for Jungermanniopsida estimated with Beast 1.6.2. Substitution rate estimates are plotted with the chronoplot function in APE (timescale in Ma).



Supplementary 2.2. Fig. 5: The Jungermanniales (mainly generalistic leafy liverworts) clade from the maximum credibility tree for Jungermanniopsida estimated with Beast 1.6.2. Substitution rate estimates are plotted with the chronoplott function in APE (timescale in Ma).

2.3. Lineages through time plots with TreeSIM

The lineages through time plots (LTTPs) were estimated with 100 randomly chosen trees from the convergence phase of the Beast 1.6.2 analysis (see 1.1.1). The resulting confidence intervals are not very large and show the same trends as the LTTPs estimated for the four clades of the maximum credibility tree (Fig. 1B). To visualize times of putative rate changes the shift times estimated with LASER are included as arrows.



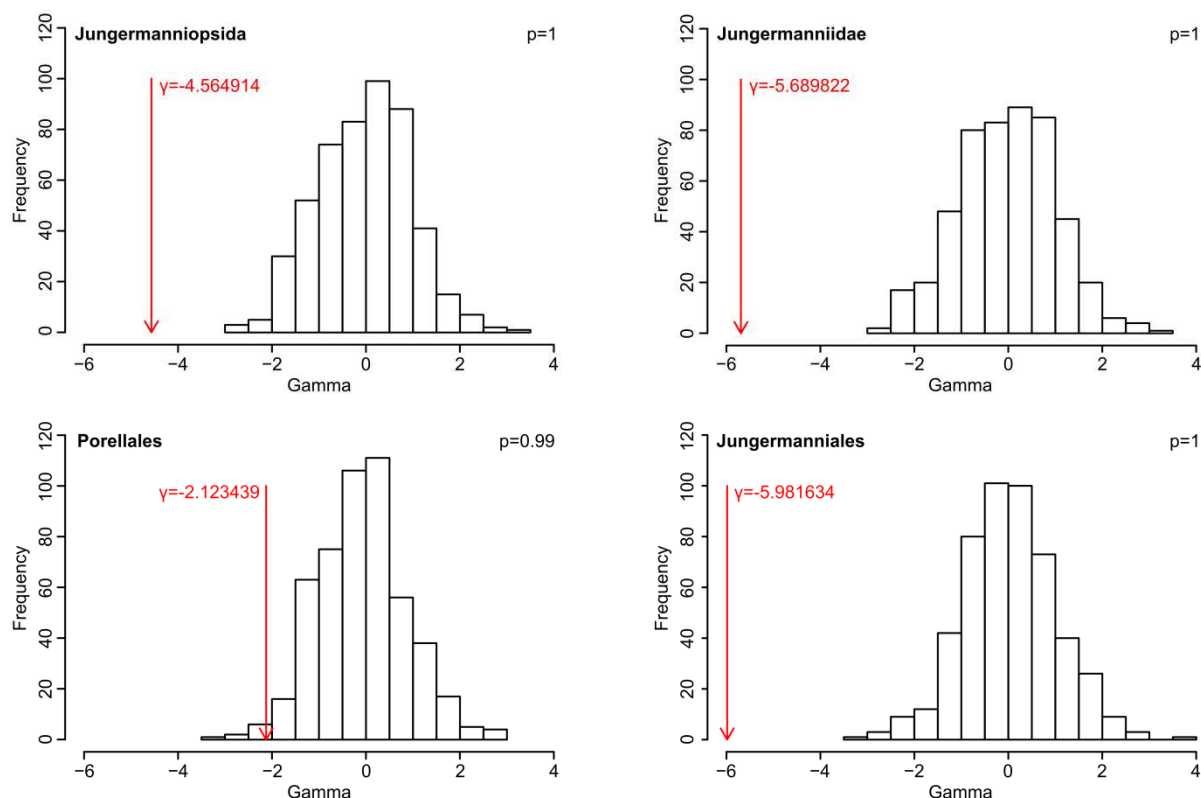
Supplementary 2.3. Fig. 1: Lineages through time plots estimated with TREESIM. The colored arrows indicate the shift times (points in time where the net diversification rate changes) estimated with the yule5rate model which was chosen with the AIC (Akaike Information Criterion) as the best fitting model in all analyses (see 2.6). The colors of the arrows correspond to the colors given to the values estimated for the yule5rate model in the model fitting with LASER (see 2.6).

2.4. Gamma Statistics with APE and MCCR test with GEIGER

The significantly negative gamma values (γ ; Supplementary 2.4. Table1) estimated for the four subsets (see 1.1.1) suggest that the cladogenic events are disproportionately distributed towards the root of the tree. This rejects the hypothesis that the diversification rates remained constant over time, indicates decreasing diversification rates and may also be an indicator of a rapid initial diversification⁸. All estimated γ values, except for Porellales, are well outside the null distribution (Supplementary 2.4. Fig. 1). The p-values indicate an overestimation of the γ due to incomplete taxon sampling. With a value of -2.1 the γ of Porellales falls just under the tail of the null distribution (Supplementary 2.4. Fig. 1).

subsets	γ (CR)	p-values (MCCR)
class Jungermannioipsida	-4.564914	1.00
subclass Jungermanniiidae	-5.689822	1.00
order Porellales	-2.123439	0.99
order Jungermanniales	-5.981634	-1.00

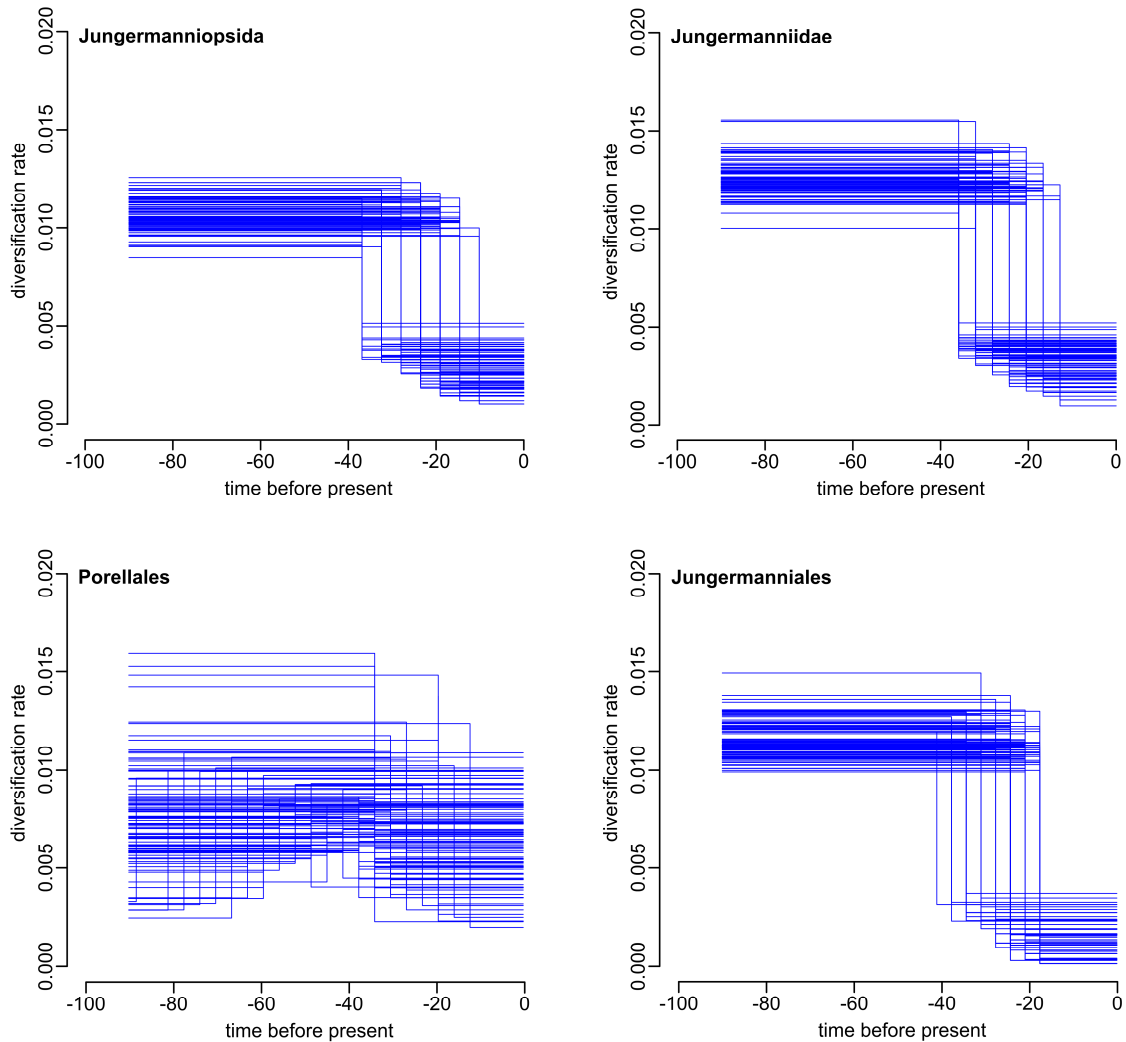
Supplementary 2.4. Table 1: Gamma statistics based on the maximum credibility tree (CR) and the p values obtained from MCCR analyses carried out to test the significance of the deviation.



Supplementary 2.4. Fig. 1: Visualisation of the null distributions of the gamma statistics with p-values derived from the MCCR test. The red arrows indicate the γ value as estimated with the CR test. All CR values were placed in the tails of the estimated distributions and were found significant.

2.5. Estimation of diversification rate shifts with TreePAR

These analyses were employed to explore rate-shifts across 100 randomly sampled trees obtained from the convergence phase of the Beast analysis for four samplings: Jungermanniopsida, Jungermannidae, Porellales, and Jungermanniales (see 1.1.1).



Supplementary 2.5. Fig. 1: Visualization of the output of the TreePAR analyses with the time towards the presents plotted on the x-axis in million years towards the present, and the diversification rates plotted onto the y-axis. The blue lines show the distribution of rates for each tree considered. All analyses recovered a reduction of the diversification rate after 40 million years towards the present, whereas most trees of the Porellales showed also an increase of the rates around 80 to 60 million years towards the present.

2.6. Modelfitting with LASER

These tables present the results obtained with the “fitdAICrc” and the “yule-n-rate” functions. The results for analyses with rate constant models are shown in Supplementary 2.6. Table 1 and the results for the rate variable models in Supplementary 2.6. Table 2. The rate constant model “pure birth” estimates only the speciation rate (λ) while the rate constant birth-death model additionally estimates the extinction rate (μ). In this analysis the pure birth model was chosen with the Akaike Information Criterion (AIC) as the best fitting constant rate model (best). The DDX and DDL models fit density dependent speciation models to branch times and assume one rate shift. The “yule-n-rate” function can estimate up to 5 rate shifts as well as the shift time based on a pure birth (yule) model. Supplementary 2.6. Table 2 shows the results for the constant rate models The yule-5-rate model was chosen as best fitting model (best in Supplementary 2.6. Table 2) based on the AIC score. It is seen here as the best fitting of all models tested because it received a better AIC score than the pure birth model.

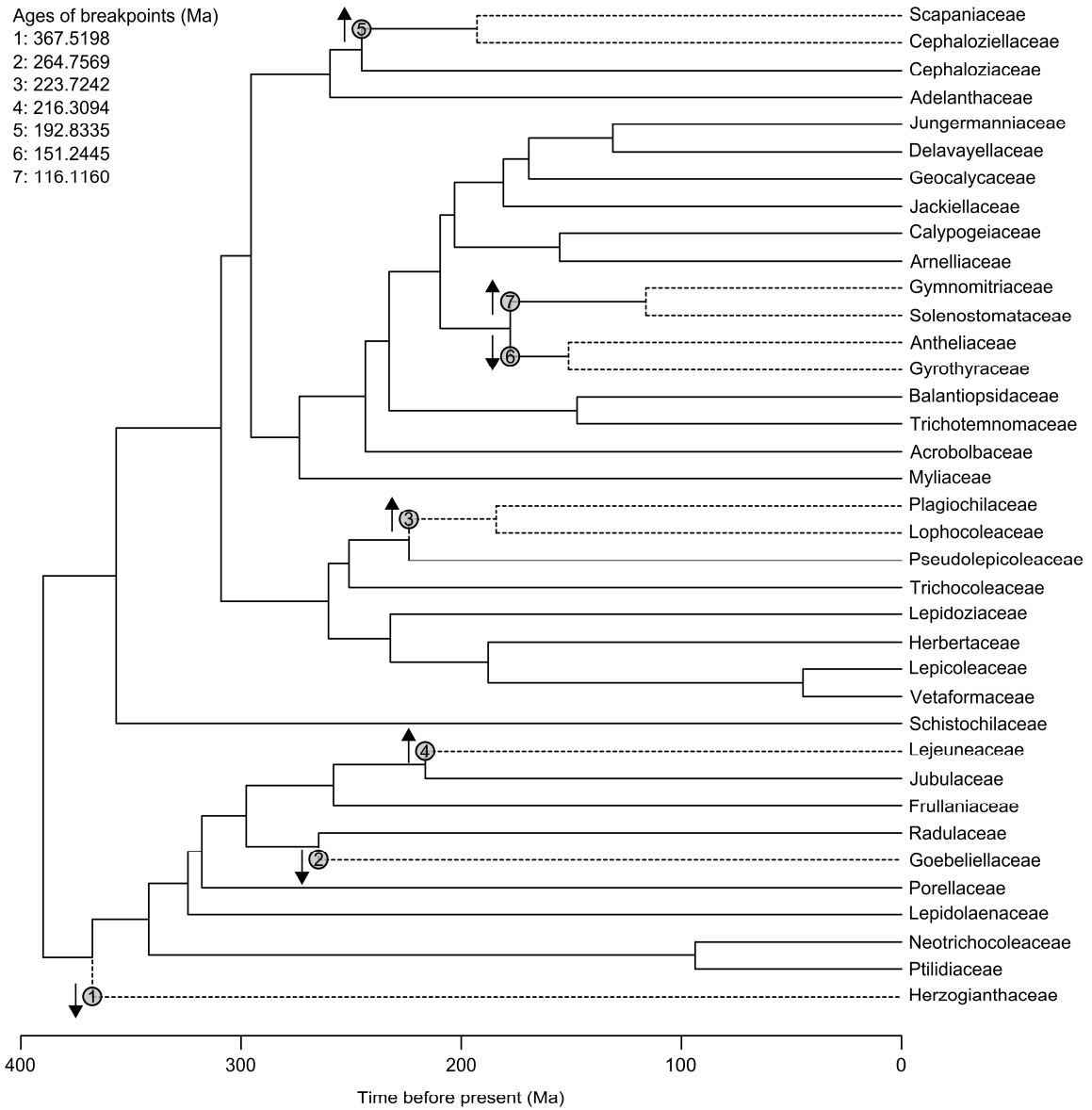
		Jungermanniopsida	Jungermanniidae	Porellales	Jungermanniales
birth-death	LH	-285.9849	-254.8856	-174.4428	-244.4738
	r1	0.009200704	0.01028827	0.01203396	0.009321269
	a	0	0	0	0
	AIC	575.9698	513.7711	352.8856	492.9477
pure birth (best)	LH	-285.9849	-254.8856	-174.4428	-244.4738
	r1	0.009200704	0.01028827	0.01203396	0.009321269
	AIC	573.9698	511.7711	350.8856	490.9477

Supplementary 2.6. Table 1: Constant rate models. LH: likelihood, r1: net diversification rate, a: extinction fraction (extinction rate/speciation rate), AIC: Akaike Information Criterion.

		DDX	DDL	yule-2-rate	yule-3-rate	yule-4-rate	yule-5-rate (best)
Jungermanniopsida	LH	-282.1289	-275.8456	-257.241	-253.675	-250.8653	-246.9981
	st1			22.15461	39.30597	126.7837	99.70935
	st2			-	19.86672	39.30597	99.70747
	st3			-	-	19.86672	39.30597
	st4			-	-	-	19.86672
	r1	0.02062544	0.01295814	0.01096744	0.01169846	0.009501562	0.01031821
	r2			0.002191284	0.007209806	0.01309443	4.767276
	r3			-	0.001913924	0.007209806	0.01304372
	r4			-	-	0.001913924	0.007209806
	r5			-	-	-	0.001913924
	xparam	0.1686242					
kparam		588.0043					
AIC	568.2578	555.6913	520.482	517.3501	515.7305	511.9961	
Jungermanniidae	LH	-249.0622	-241.3152	-222.7671	-218.1685	-216.3685	-212.2882
	st1			7.68709287	39.30597	45.31878	99.70935
	st2				22.15461	39.30597	99.70747
	st3					22.15461	39.30597
	st4						22.15461
	r1	0.02818721	0.01475296	0.01108866	0.01383550	0.01327448	0.01245346
	r2			0.00100480	0.008075279	0.02033167	6.067443
	r3				0.002125048	0.008075279	0.01483371
	r4					0.002125048	0.008075279
	r5						0.002125048
	xparam	0.2147198					
kparam		520.008					
AIC	502.1244	486.6303	451.53413758	446.3370	446.7370	442.5764	
Porellales	LH	-174.3698	-171.849	-165.6515	-156.6528	-154.2654	-150.5121
	st1			31.41612	126.7582	258.0115	126.7582
	st2				39.3607	146.0875	99.70935
	st3					39.3607	99.70747
	st4						39.3607
	r1	0.01384789	0.01682349	0.01555346	0.006075057	0.01262621	0.006075057
	r2			0.005681468	0.02155635	0.002071221	0.02438414
	r3				0.006595756	0.02082457	24.26977
	r4					0.006595756	0.02075619
	r5						0.006595756
	xparam	0.03783327					
kparam		206.0333					
AIC	352.7395	347.698	337.303	323.3055	322.5309	319.0241	
Jungermanniales	LH	-235.4998	-232.1471	-214.3916	-209.1985	-206.1352	-203.6757
	st1			23.18535	66.24705	67.8467	59.83692
	st2				22.87056	67.26448	56.06216
	st3					22.87056	55.98609
	st4						22.87056
	r1	0.0417538	0.0137402	0.01177409	0.01356653	0.01304987	0.01317913
	r2			0.0005503569	0.009411897	0.06872758	0.002408339
	r3				0.0002789234	0.00959347	0.2363308
	r4					0.0002789234	0.009717596
	r5						0.0002789234
	xparam	0.3517625					
kparam		314.023					
AIC	474.9995	468.2943	434.7831	428.3969	426.2703	425.3514	

Supplementary 2.6. Table 2: Rate variable models. Colored values refer to the LTTPs in Supplementary 2.3 Fig. 1. LH: likelihood, st: shift time, r1-5: net diversification rates, xparam: the x parameter in the density dependent exponential model, kparam: the K parameter in the logistic density dependent model, AIC: Akaike Information Criterion.

2.7. MEDUSA



Supplementary 2.7. Fig. 1: Results of the MEDUSA analysis of the Jungermanniidae families. Breakpoints (diversification shift) estimated with the best model (yule) chosen with the corrected Akaike Information Criterion (AICc) and the times of the breaks. Arrows indicate an increased (up) or decreased (down) rate. The breakpoints are also shown in Fig. 1A using the same numbering scheme. Dashed lines indicate breakpoints placed at the crown of the clade, whereas continued lines indicate breakpoints at the stem of the clade.

2.8. BiSSE

Summary of the BiSSE analyses with and without the addition of DIVERSTREE analyses carried out to test evidence suggesting dependence of diversification rate changes from ecological preferences. We added also a BiSSE independent test (Supplementary 2.8.1. Table 1).

2.8.1. Wilcoxon statistics to explore rate dependence of ecological preferences in sister clades

Clades with more than 50% epiphytes were considered as epiphytic, whereas clades with less than 50% epiphytes were classified as generalists. Test for group 1 and 2 compared the diversification rates of families classified as epiphytes versus families classified as generalists. Group 3 and 4 compared the difference in the diversification rates of sister clades sharing the same ecological preference or show distinct ecological differences.

Test	z-value	p-value
Group 1 & 2 Rates of epiphytes versus generalists	-0.94388	0.345
Group 3 & 4 Rate changes in sister clades with either the same ecological preferences or different ecological preferences	-1.98762	0.046

Supplementary 2.8.1 Table 1: Results of Wilcoxon statistics. $P < 0.5$ was considered to be significant. Thus, rate changes are associated with sister clades showing the transformation of ecological preferences, while epiphytic families did not show significant differences in their speciation rate compared to generalist families.

2.8.2. BiSSE with DIVERSITREE

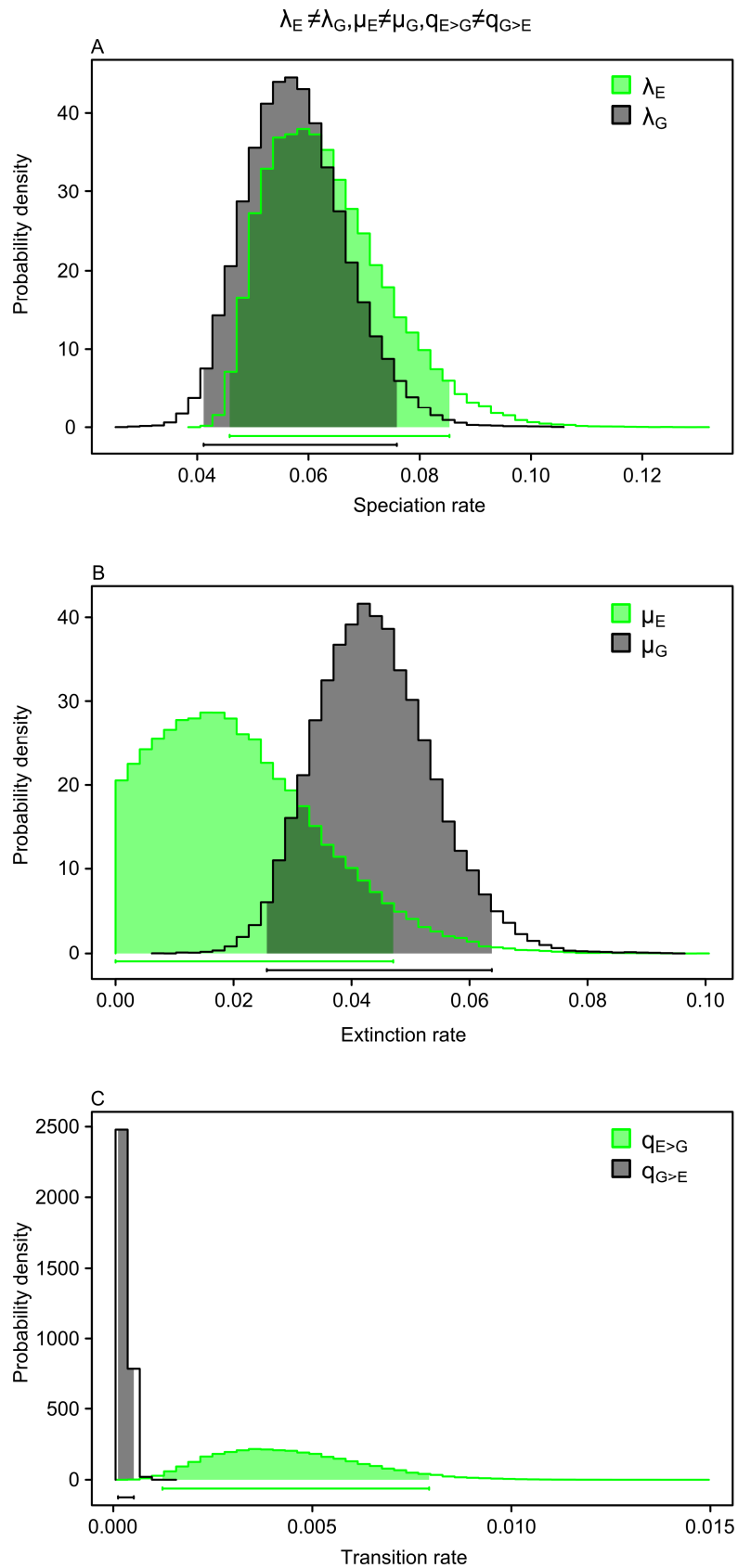
For the BiSSE analysis with DIVERSITREE a character matrix with the substrate preference (E = epiphytic, G = generalistic) was assigned to the maximum credibility tree of Jungermannopsida. Speciation rates (λ), extinction rates (μ) and character state transitions between the states (q) were estimated with maximum likelihood and Bayesian inference. The analyses were performed with several parameter settings for which the likelihood and Akaike Information Criterion (AIC) values of the maximum likelihood estimation were best: 6 parameter ($\lambda_E \neq \lambda_G, \mu_E \neq \mu_G, q_{E>G} \neq q_{G>E}$ are estimated independently), 5 parameter ($\lambda_E = \lambda_G, \mu_E \neq \mu_G, q_{E>G} \neq q_{G>E}; \lambda_E \neq \lambda_G, \mu_E = \mu_G, q_{E>G} \neq q_{G>E}, \lambda_E \neq \lambda_G, \mu_E \neq \mu_G, q_{E>G} = q_{G>E}$) and 4 parameter ($\lambda_E = \lambda_G, \mu_E = \mu_G, q_{E>G}, q_{G>E}; \lambda_E \neq \lambda_G, \mu_E = \mu_G, q_{E>G} = q_{G>E}; \lambda_E = \lambda_G, \mu_E \neq \mu_G, q_{E>G} = q_{G>E}$). The p-values indicate that the differences between the variables of all models are significant.

	ML	λ_E	λ_G	μ_E	μ_G	$q_{E>G}$	$q_{G>E}$	lnLik
1	$\lambda_E \neq \lambda_G, \mu_E \neq \mu_G, q_{E>G} \neq q_{G>E}$	0.08385	0.07077	0.04731	0.05809	0.00410	0.00031	-1728.951
2	$\lambda_E = \lambda_G, \mu_E \neq \mu_G, q_{E>G} \neq q_{G>E}$	0.07489		0.03652	0.06256	0.00448	0.00026	-1729.185
3	$\lambda_E \neq \lambda_G, \mu_E = \mu_G, q_{E>G} \neq q_{G>E}$	0.09095	0.06871	0.05545		0.00265	0.00039	-1728.976
4	$\lambda_E \neq \lambda_G, \mu_E \neq \mu_G, q_{E>G} = q_{G>E}$	0.11683	0.06444	0.08713	0.05015	0.00070		-1732.712
5	$\lambda_E = \lambda_G, \mu_E = \mu_G, q_{E>G} \neq q_{G>E}$	0.10918		0.09505		0.00149	0.00074	-1750.202
6	$\lambda_E \neq \lambda_G, \mu_E = \mu_G, q_{E>G} = q_{G>E}$	0.09183	0.07174	0.05817		0.00050		-1733.682
7	$\lambda_E = \lambda_G, \mu_E \neq \mu_G, q_{E>G} = q_{G>E}$	0.07901		0.04377	0.06591	0.00040		-1735.377

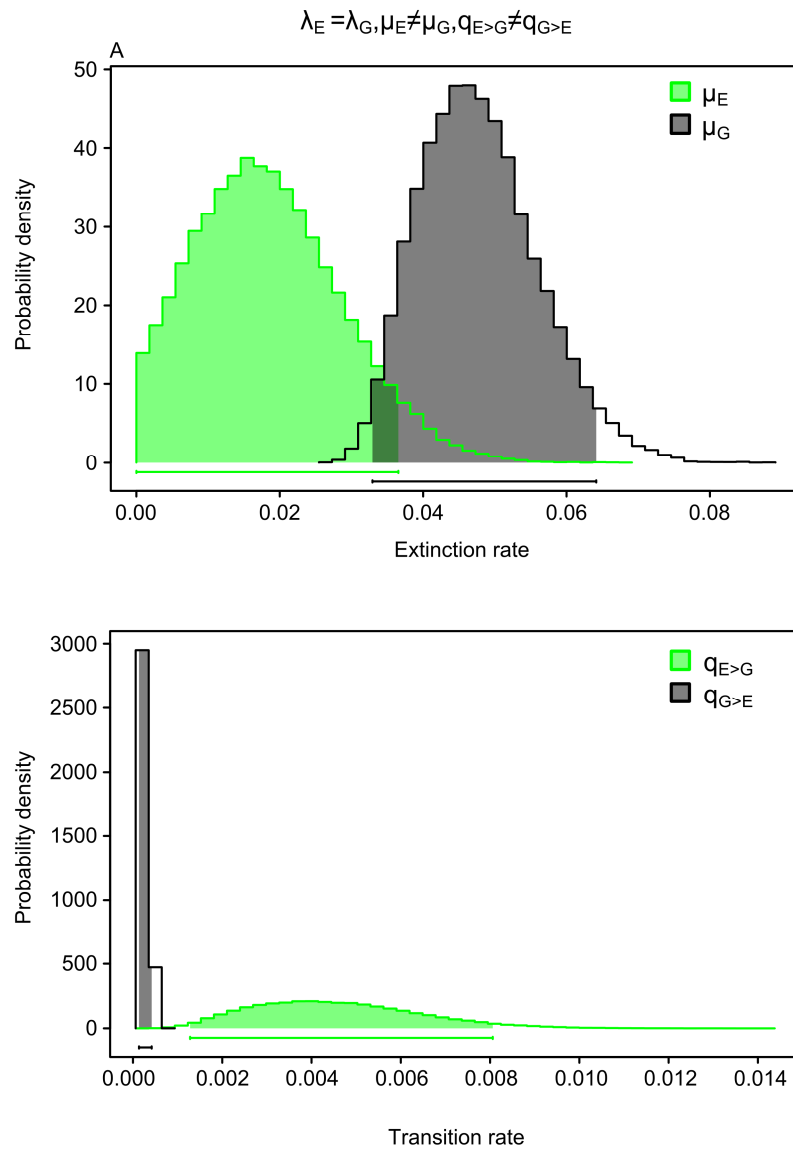
Supplementary 2.8.2. Table 1: Results of the maximum likelihood analyses for 7 parameter settings.

	Parameter	mcmc	quant.	λ_E	λ_G	μ_E	μ_G	$q_{E>G}$	$q_{G>E}$	p
1	$\lambda_E \neq \lambda_G, \mu_E \neq \mu_G, q_{E>G} \neq q_{G>E}$	1	95%	0.03493	0.02984	0.04453	0.03275	0.00585	0.00034	-
		2	2.5%	0.04755	0.04214	0.00123	0.026484	0.00151	0.00014	0.001723
			97.5%	0.08906	0.07725	0.05318	0.06494	0.00838	0.00056	0.001717
2	$\lambda_E = \lambda_G, \mu_E \neq \mu_G, q_{E>G} \neq q_{G>E}$	1	95%	0.02479		0.03351	0.02703	0.00593	0.00024	-
		2	2.5%	0.04893		0.00180	0.03402	0.00158	0.00015	0.001723
			97.5%	0.078		0.04027	0.06573	0.00854	0.00044	0.001718
3	$\lambda_E \neq \lambda_G, \mu_E = \mu_G, q_{E>G} \neq q_{G>E}$	1	95%	0.02561	0.02737	0.03003		0.00476	0.00034	-
		2	2.5%	0.06548	0.04129	0.02547		0.001297	0.000227	0.001726
			97.5%	0.09617	0.07397	0.06116		0.006829	0.000626	0.001720
4	$\lambda_E \neq \lambda_G, \mu_E \neq \mu_G, q_{E>G} = q_{G>E}$	1	95%	0.04902	0.02871	0.05884	0.03184	0.00058		-
		2	2.5%	0.05467	0.03855	0.01247	0.02115	0.00029		0.001733
			97.5%	0.11252	0.07356	0.08238	0.06001	0.00098		0.001727
5	$\lambda_E = \lambda_G, \mu_E = \mu_G, q_{E>G} \neq q_{G>E}$	1	95%	0.03492		0.03749		0.00187	0.00067	-
		2	2.5%	0.07511		0.05834		0.00076	0.00043	0.001750
			97.5%	0.11912		0.10551		0.00299	0.0012	0.001745
6	$\lambda_E \neq \lambda_G, \mu_E = \mu_G, q_{E>G} = q_{G>E}$	1	95%	0.02639	0.02831	0.03096		0.00036		-
		2	2.5%	0.06528	0.04346	0.02702		0.00033		0.001734
			97.5%	0.09598	0.07606	0.06273		0.00076		0.001729
7	$\lambda_E = \lambda_G, \mu_E \neq \mu_G, q_{E>G} = q_{G>E}$	1	95%	0.02763		0.03585	0.03003	0.00029		-
		2	2.5%	0.05072		0.00694	0.03495	0.00024		0.001734
			97.5%	0.08257		0.04870	0.06963	0.00059		0.001728

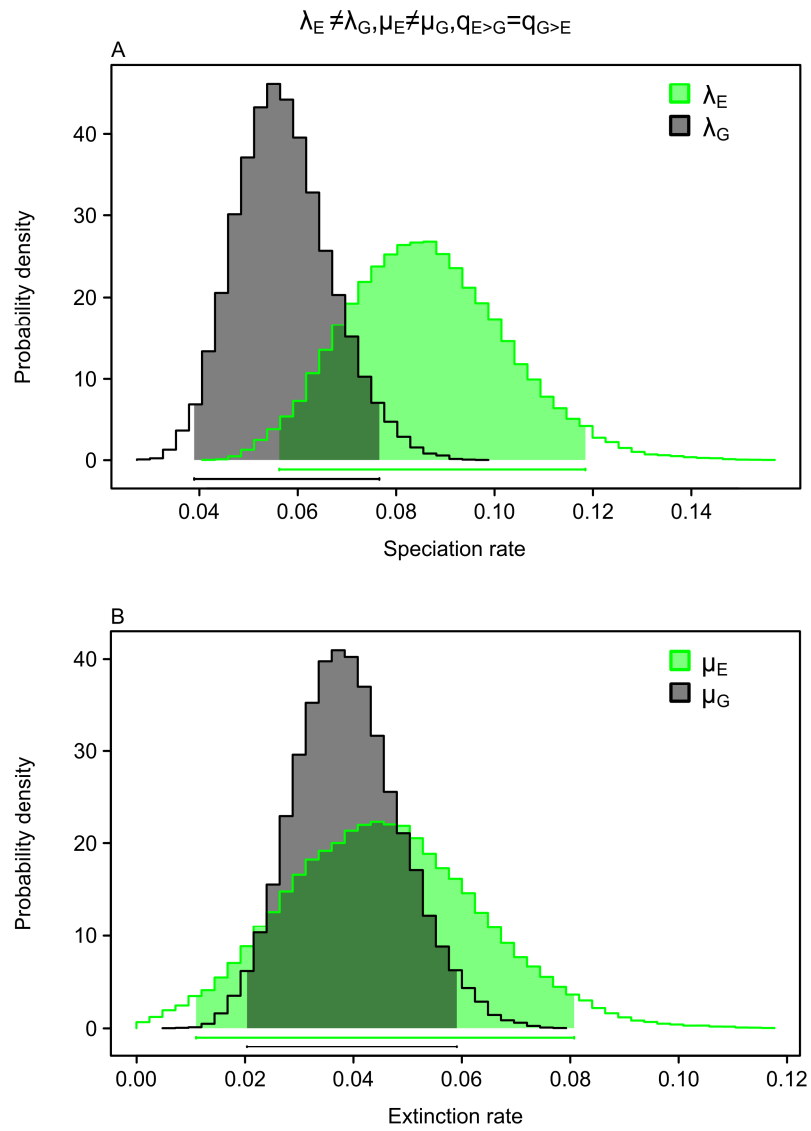
Supplementary 2.8.2. Table 2: Results of the BiSSE analysis with diversitree. MCMC 1 results are from the 95% quantile of the first MCMC analysis that is done to optimize the model values. MCMC 2 results are from the second MCMC analysis run with the optimized model. The 2.5% values are from the outer margins of the posterior distribution, the 97.5% values represent the inner part of the distribution.



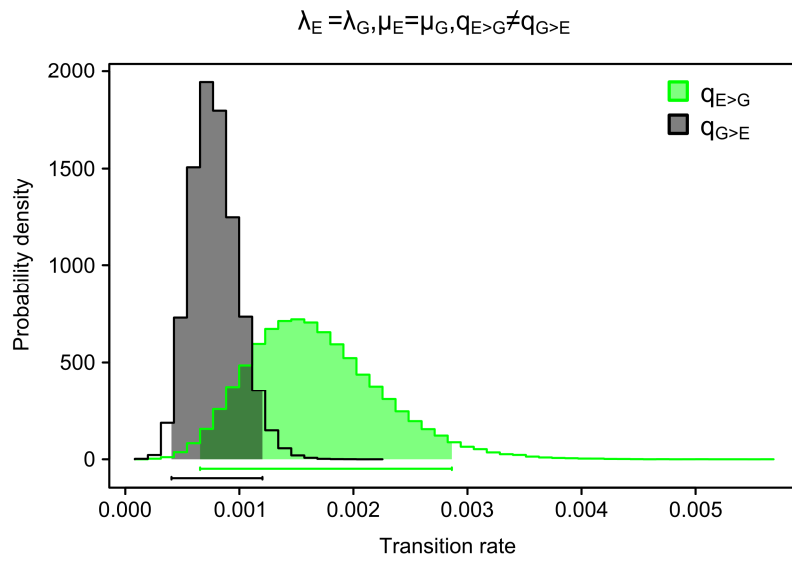
Supplementary 2.8.2. Fig. 1: Posterior probability distribution from the analysis with 6 variable parameters (λ : speciation rates, μ : extinction rates, q : transition rates).



Supplementary 2.8.2. Fig. 1: Posterior probability distribution from the analysis with constant speciation rates λ (μ : extinction rates, q : transition rates).



Supplementary 2.8.2. Fig. 1: Posterior probability distribution from the analysis with constant transition rates q (λ : speciation rates, μ : extinction rates).

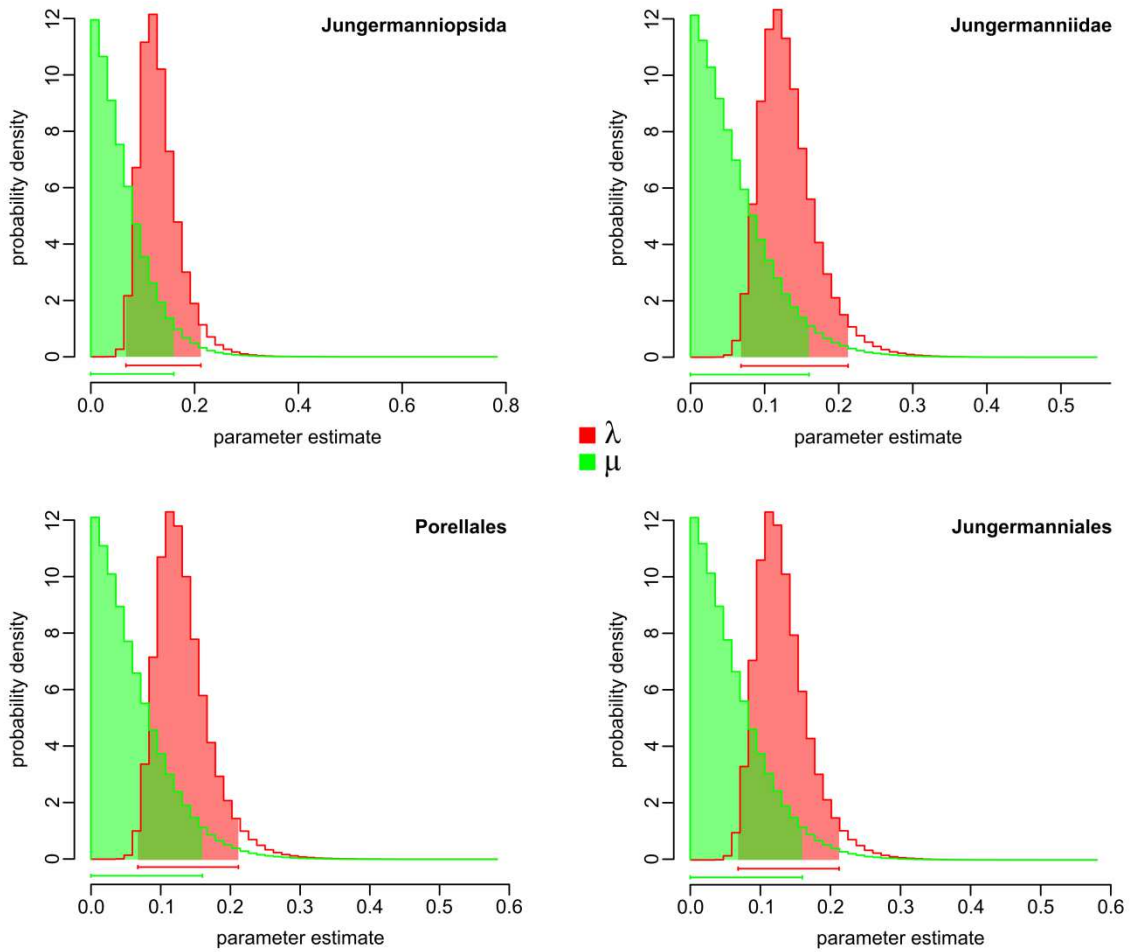


Supplementary 2.8.2. Fig. 1: Posterior probability distribution from the analysis with constant speciation rates λ and constant extinction rates μ (q : transition rates).

2.9. Estimation of speciation and extinction rates with DIVERSITREE

	find.mle		mle estimation	
	λ	μ	λ	μ
Jungermanniopsida	0.009200707	0.000000000	8.932355e-03	7.699746e-07
Jungermanniidae	0.01028827	0.000000000	0.01028827	0.00000000
Porellales	0.009321272	0.000000000	0.01203397	0.00000000
Jungermanniales	0.009321272	0.000000000	0.009321272	0.00000000

Supplementary 2.9. Table 1: Estimated speciation (λ) and extinction rates (μ).



Supplementary 2.9 Fig. 1: Results of the mcmc-cross-validation of the birth-death model: posterior probability distributions of the speciation (λ) and extinction (μ) rates for the four subclades (see 1.1.1).

Supplementary Information 3: References

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Supplementary Information 4: Accession numbers

Species	Voucher (Herbarium)	Origin	GenBank Acc.- Nos. rbcL
Outgroup: Marchantiopsida			
<i>Asterella wallichiana</i> (Lehm. & Lindenb.) Grolle	Long 30251 (E)	Nepal	DQ286001
<i>Blasia pusilla</i> L.	Tsubota 2538 (HIRO)	Japan	AB476555
<i>Conocephalum japonicum</i> (Thunb.) Grolle	Long 30724 (E)	Nepal	DQ286005
<i>Dumortiera hirsuta</i> (Sw.) Nees	Long et al. 29627 (E)	Mexico	DQ286009
<i>Lunularia cruciata</i> (L.) Dumort. ex Lindb.	Long 29553 (E)	Mexico	DQ286011
<i>Marchantia polymorpha</i> L.	Mishler 3783 (DUKE)	USA	U87079
<i>Monoclea gottschei</i> Lindb.	Long et al. 29637 (E)	Mexico	DQ286016
<i>Riccia fluitans</i> L.	Cady s.n. (E)	USA	DQ286023
<i>Sphaerocarpos texanus</i> Austin	Stotler & Crandall-Stotler 1515 (ABSH)	USA	AY507425
Ingroup: Jungermanniopsida			
Pelliidae			
<i>Allisonia cockaynii</i> (K.I.Goebel) R.M.Schust.	Stotler & Crandall-Stotler 4470 (ABSH)	New Zealand	AY507389
<i>Calycularia crispula</i> Mitt.	Furuki 20741 (HIRO)	Japan	AB476556
<i>Fossombronina australis</i> Mitt.	Stotler & Crandall-Stotler 4610 (ABSH)	New Zealand	AY507392
<i>Fossombronina foveolata</i> Lindb.	D. & S. Williams s.n. (ABSH)	USA	AY507399
<i>Fossombronina porphyrorhiza</i> (Nees) Prosk.	Gradstein 9831 (ABSH)	Brazil	AF536234
<i>Greeneothallus gemmiparus</i> Hässel	Long 31831 (E)	Argentina	AY688780
<i>Hattorianthus erimonus</i> (Steph.) R.M.Schust. & Inoue	Furuki s.n. (ABSH)	Japan	AY507403
<i>Hymenophyton flabellatum</i> (Labill.) Dumort.	Stotler & Crandall-Stotler 4511 (ABSH)	New Zealand	AY507406
<i>Jensenia spinosa</i> (Lindenb. & Gottsche) Grolle	Villarreal 793 (ABSH)	Venezuela	AY734689
<i>Makinoa crispata</i> (Steph.) Miyake	Stotler & Crandall-Stotler 4047 (ABSH)	China	AY877390
<i>Moerckia flotoviana</i> (Nees) Schiffn.	Kinser & Schuette 709 (ABSH)	USA	AY507413
<i>Noteroclada confluens</i> Taylor	Weiss & Schwerdtfeger s.n. (ABSH)	Ecuador	HM005729
<i>Pallavicinia lyellii</i> (Hook.) Gray	Marsh s.n. (ABSH)	USA	AY507416
<i>Pellia epiphylla</i> (L.) Corda	Forrest et al. 700 (ABSH)	United Kingdom	HM005732
<i>Petalophyllum ralfsii</i> (Wilson) Nees & Gottsche	J. Proskauer culture via D. Mueller-TAMU (in ABSH)	United Kingdom	AY507417
<i>Phyllohallia nivicola</i> E.A.Hodgs.	Stotler & Crandall-Stotler 4537 (ABSH)	New Zealand	AY507418
<i>Podomitrium phyllanthus</i> (Hook.) Mitt.	Stotler & Crandall-Stotler 4517 (ABSH)	New Zealand	AY507419
<i>Symphyogyna hymenophyllum</i> (Hook.) Mont. & Nees	Stotler & Crandall-Stotler 4452 (ABSH)	New Zealand	AY507426
<i>Symphyogyna undulata</i> Colenso	Stotler & Crandall-Stotler 4463 (ABSH)	New Zealand	AY688790
<i>Symphyogynopsis filicum</i> (Nadeaud) Grolle	Tazawa 222 (HIRO)	Malaysia	AB476601
<i>Xenothallus vulcanicolus</i> R.M.Schust.	Stotler & Crandall-Stotler 4580 (ABSH)	New Zealand	AY507431
Metzgeriidae			
<i>Aneura pinguis</i> (L.) Dumort.	Yamaguchi 25538 (HIRO)	Japan	AB476550
<i>Lobatiriccardia lobata</i> (Schiffn.) Furuki	Glenny & Kinser 4581 (ABSH)	New Zealand	AY507421
<i>Metzgeria caledonica</i> Steph.	Oguri s.n. (HIRO)	New Caledonia	AB535638
<i>Metzgeria consanguinea</i> Schiffn.	Masuzaki 542 (HIRO)	Japan	AB535640
<i>Metzgeria fruticosa</i> Spruce	Davis 361 (DUKE)	Ecuador	AY608035
<i>Metzgeria furcata</i> (L.) Corda	Hentschel Bryo 01759 (GOET)	Germany	AM384875
<i>Metzgeria pubescens</i> (Schrank) Raddi	Long 29523 (E)	United Kingdom	DQ268967
<i>Mizutania riccardioides</i> Furuki & Z.Iwats.	Masuzaki 147 (HIRO)	Malaysia	AB476582
<i>Pleurozia purpurea</i> Lindb.	Long 28868 (E)	Bhutan	AY877391
<i>Riccardia capillacea</i> (Steph.) Meenks & C.DeJong	Forrest 558 (ABSH)	Venezuela	AY877392
<i>Riccardia multifida</i> (L.) Gray	Forrest & Badcock 601 (ABSH)	Canada	DQ268980
<i>Riccardia vitrea</i> Furuki	Furuki 19806 (HIRO)	Japan	AB476596
<i>Verdoornia succulenta</i> R.M.Schust.	Stotler & Crandall-Stotler 4602	New Zealand	AY507430

	(ABSH)		
Jungermanniiidae			
<i>Acanthocoleus aberrans</i> (Lindenb. & Gottsche) Kruijt	Schäfer-Verwimp & Verwimp 4213 (GOET)	Spain	DQ983647
<i>Acrobolbus ciliatus</i> (Mitt.) Schiffn.	Long 30514 (E)	Nepal	DQ026579
<i>Acrolejeunea fertilis</i> (Reinw., Blume & Nees) Spruce	Gradstein et al. 10358 (GOET)	Malaysia	DQ983650
<i>Acromastigum exiguum</i> (Steph.) A.Evans	NSW700366 (NSW)	Australia	EF100974
<i>Acromastigum tenax</i> (Steph.) A.Evans	NSW701861 (NSW)	New Caledonia	EF100979
<i>Adelanthus lindenbergianus</i> (Lehm.) Mitt.	Jacome JJ1045 (GOET)	Bolivia	GQ900284
<i>Alobiella husnotii</i> Schiffn.	Schäfer-Verwimp & Verwimp 17800 (GOET)	Dominica	KC184698
<i>Anastrophyllum bidens</i> (Reinw., Blume & Nees) Steph.	Gradstein 12067 (GOET)	Indonesia	KC184700
<i>Anastrophyllum piligerum</i> (Reinw., Blume & Nees) Steph.	Schäfer-Verwimp et al. 24271 (GOET)	Ecuador	KC184704
<i>Andrewsianthus perigonialis</i> (Hook. & Taylor) R.M.Schust.	Engel & von Konrat 27283 (GOET)	New Zealand	KC184707
<i>Andrewsianthus australis</i> J.J.Engel	Schäfer-Verwimp & Verwimp 23734 (GOET)	Thailand	KC184706
<i>Anopolejeunea conferta</i> (C.F.W.Meissn. ex Spreng.) A.Evans	Wilson et al. 04-08 (GOET)	Ecuador	DQ983653
<i>Anthelia julacea</i> (L.) Dumort.	Long 31292 (E)	Nepal	DQ026581
<i>Archeophylla schusteri</i> (E.A.Hodgs. & Allison) R.M.Schust.	Glenny 9892b (H)	New Zealand	FJ173308
<i>Archilejeunea parviflora</i> (Nees) Steph.	Gradstein & Dauphin 9370 (GOET)	Costa Rica	DQ983657
<i>Ascidiota blepharophylla</i> subsp. <i>alaskana</i> Steere & R.M.Schust.	Lewis 514 (F)	USA	EF545280
<i>Aureolejeunea fulva</i> R.M.Schust.	Costa & Gradstein 3849 (GOET)	Brazil	AY548083
<i>Balantiopsis diplophylla</i> (Hook. f. & Taylor) Mitt.	Furuki 19645 (HIRO)	Australia	AB476553
<i>Barbilophozia barbata</i> (Schreb.) Loeske	Hentschel Bryo 0753 (GOET)	Bulgaria	DQ312477
<i>Barbilophozia hatcheri</i> (A.Evans) Loeske	Bakalin 53 (GOET)	Kamchatka	KC184708
<i>Bazzania fasciculata</i> (Steph.) D.Meagher	NSW605694 (NSW)	Australia	EF100980
<i>Bazzania franciana</i> (Steph.) N.Kitag.	NSW611491 (NSW)	New Caledonia	EF100981
<i>Bazzania tricrenata</i> (Wahlenb.) Trevis.	Heinrichs et al. 4388 (GOET)	Austria	AY699990
<i>Bazzania tridens</i> (Reinw., Blume & Nees) Trevis.	Masuzaki 304 (HIRO)	Japan	AB476554
<i>Blepharolejeunea incongrua</i> (Lindenb. & Gottsche) Slageren & Kruijt	Schäfer-Verwimp & Verwimp 12800 (GOET)	Brazil	DQ983659
<i>Brevianthus flavus</i> (Grolle) J.J.Engel & R.M.Schust.	Glenny 8918 (CHR)	New Zealand	DQ026582
<i>Bryopteris diffusa</i> (Sw.) Nees	Acebey & Villavincencio 885 (GOET)	Bolivia	AY548085
<i>Calypogeia integristipula</i> Steph.	Furuki 20768 (HIRO)	Japan	AB476557
<i>Calypogeia muelleriana</i> (Schiffn.) K.Müller	Hentschel Bryo 01340 (GOET)	Germany	AM392302
<i>Castanoclobos julaceus</i> (Hatcher ex J.J.Engel) J.J.Engel & Glenny	Glenny 10122 (CHR)	Australia	FJ173309
<i>Caudalejeunea recurvistipula</i> (Gottsche) Schiffn.	Gradstein et al. 10378 (GOET)	Malaysia	DQ983661
<i>Cephalozia bicuspidata</i> (L.) Dumort.	Hentschel Bryo 0362 (GOET)	Germany	AM392307
<i>Cephalozia macgregorii</i> (Steph.) R.M.Schust.	Koponen 35296 (GOET)	Papua New Guinea	KC184732
<i>Cephaloziella granatensis</i> (J.B.Jack) Fulford	Dauphin et al. 1548 (GOET)	Panama	KC184715
<i>Cephaloziella microphylla</i> (Steph.) Douin	Schäfer-Verwimp & Verwimp 16291 (GOET)	Thailand	KC184716
<i>Cephaloziella stellulifera</i> (Taylor) Schiffn.	Doyle 11250 (GOET)	USA	KC184718
<i>Cephaloziopsis intertexta</i> (Gottsche) R.M.Schust.	Linneo et al. 424 (GOET)	Bolivia	KC184720
<i>Ceratolejeunea cornuta</i> (Lindenb.) Schiffn.	Drehwald 4739 (GOET)	Bolivia	AY548088
<i>Ceratolejeunea grandiloba</i> J.B.Jack & Steph.	Gradstein 7055 (GOET)	Bolivia	AY548090
<i>Chaetophyllopsis whiteleggei</i> (Carrington & Pearson) R.M.Schust.	Curnow 4804 (GOET)	Australia	AY462292
<i>Cheilolejeunea acutangula</i> (Nees) Grolle	Gradstein & Velasquez s.n. (GOET)	Mexico	DQ983664
<i>Cheilolejeunea meyeniana</i> (Gottsche, Lindenb. & Nees) R.M.Schust. & Kachroo	Schäfer-Verwimp & Verwimp 24836/C (GOET)	Indonesia	DQ983666
<i>Cheilolejeunea</i> spec.	Schäfer-Verwimp & Verwimp 24836/C (GOET)	Indonesia	KJ508344
<i>Cheilolejeunea trifaria</i> (Reinw., Blume & Nees) Mizut.	Gradstein 9951A (GOET)	Bolivia	AY548093
<i>Chiastocaulon dendroides</i> (Nees) Carl	Kurita 84 (HIRO)	Japan	AY699991
<i>Chiloscyphus fragmentissimus</i> (R.M.Schust.) J.J.Engel & R.M.Schust.	Frahm 97/5/N (GOET)	Venezuela	DQ312480
<i>Chiloscyphus fragrans</i> (Moris & De Not.) J.J.Engel & R.M.Schust.	Schwab 113 (JE)	Portugal	DQ312484
<i>Chiloscyphus muricatus</i> (Lehm.) J.J.Engel & R.M.Schust.	Streimann 51629 (JE)	Australia	DQ312486
<i>Chiloscyphus polyanthos</i> (L.) Corda	Hentschel Bryo 01758 (GOET)	Germany	AM392318

<i>Chiloscyphus profundus</i> (Nees) J.J.Engel & R.M.Schust.	He Nygren & Piippo 1470 (H)	Finland	AY149852
<i>Chiloscyphus sabuletorum</i> (Hook. f. & Taylor) J.J.Engel & R.M.Schust.	Busch et al. Bryo 01396 (JE)	Chile	DQ312488
<i>Chiloscyphus semiteres</i> (Lehm.) Lehm. & Lindenb.	Streimann 58464 (GOET)	Australia	DQ312489
<i>Cololejeunea laevigata</i> (Mitt.) R.M.Schust.	von Konrat 81-503 (GOET)	New Zealand	DQ238563
<i>Cololejeunea obliqua</i> (Nees & Mont.) Schiffn.	Wilson et al. 04-11 (GOET)	Ecuador	DQ983669
<i>Cololejeunea metzgeriopsis</i> (K.I.Goebel) Gradst. et al.	Ilkiu-Borges et al. 2946 (GOET)	Malaysia	DQ238567
<i>Cololejeunea vitalana</i> Tixier	Schäfer-Verwimp & Holz SV/H-0473/A (GOET)	Costa Rica	DQ238564
<i>Colura acroloba</i> (Mont. ex Steph.) Jovet-Ast	Pócs 03261/BK (GOET)	Republic of Fiji	DQ238565
<i>Colura imperfecta</i> Steph.	Pócs 03261/BA (GOET)	Republic of Fiji	DQ238566
<i>Colura tortifolia</i> (Mont. & Nees) Trevis.	Wilson et al. 04-12 (GOET)	Ecuador	DQ983671
<i>Cryptolophocolea connata</i> (Sw.) L.Söderstr. & Váña	Gradstein 9404 (GOET)	Costa Rica	DQ312483
<i>Cuspidatula monodon</i> Steph.	Pócs & Streimann 99189/B (EGR)	Australia	GQ900299
<i>Cyclolejeunea peruviana</i> (Lehm. & Lindenb.) A.Evans	Gradstein 8546 (GOET)	Colombia	DQ983672
<i>Cylindrocolea recurvifolia</i> (Steph.) Inoue	Deguchi 36641 (HIRO)	Japan	AM392306
<i>Delavayella serrata</i> Steph.	Long 30388 (E)	Nepal	DQ026583
<i>Dendrolejeunea fruticosa</i> (Lindenb. & Gottsche) Lacout.	Ilkiu-Borges & Yong 3026 (GOET)	Malaysia	DQ983673
<i>Dendromastigophora flagellifera</i> (Hook.) R.M.Schust.	Glenny 8520 (CHR)	New Zealand	AY462294
<i>Dicranolejeunea axillaris</i> (Nees & Mont.) Schiffn.	Drehwald 4829 (GOET)	Bolivia	DQ983674
<i>Diplasiolejeunea cavifolia</i> Steph.	Schäfer-Verwimp & Verwimp 19036/A (GOET)	Malaysia	JQ729531
<i>Diplasiolejeunea involuta</i> S.Winkl. ssp. <i>andicola</i> Pócs	Schäfer-Verwimp & Verwimp 23508 (GOET)	Ecuador	AY548096
<i>Diplasiolejeunea villaumei</i> Steph.	Pócs et al. 04042/QR (EGR)	Kenya	JQ729467
<i>Diplophyllum albicans</i> (L.) Dumort.	Hentschel Bryo 0240 (GOET)	Germany	AM392309
<i>Diplophyllum taxifolium</i> (Wahlenb.) Dumort.	Hentschel Bryo 02044 (JE)	Germany	KJ508343
<i>Douinia ovata</i> (Dicks.) H.Buch	Schofield & Davidson 1809 (GOET)	Canada	KC184724
<i>Drepanolejeunea biocellata</i> A.Evans	Gradstein et al. 10053 (GOET)	Ecuador	AY548097
<i>Drepanolejeunea erecta</i> (Steph.) Mizut.	Koponen et al. 50605 (H)	China	AY125940
<i>Drepanolejeunea spec.</i>	Ilkiu-Borges et al. 3024 (GOET)	Malaysia	DQ983678
<i>Drepanolejeunea vesiculosa</i> (Mitt.) Steph.	Gradstein et al. 10372 (GOET)	Malaysia	DQ983679
<i>Drucella integristipula</i> (Steph.) E.A.Hodgs.	Brown 08/219 (NSW)	New Zealand	JF316287
<i>Eocalypogeia quelpartensis</i> (S.Hatt. & Inoue) R.M.Schust.	Furuki 20233 (HIRO)	Japan	AB476566
<i>Eotrichocolea polyacantha</i> (Hook. f. & Taylor) R.M.Schust.	Glenny 9891b (CHR)	New Zealand	FJ173322
<i>Eremonotus myriocarpus</i> (Carrington) Pearson	Rothero NH 2116-2410 (GOET)	United Kingdom	EF503674
<i>Evansiolejeunea roccatii</i> Vanden Berghen	Fischer RWA-1120 (GOET)	Rwanda	DQ983680
<i>Frullania atrata</i> (Sw.) Dumort.	Costa & Gradstein 3859 (GOET)	Brazil	FJ380853
<i>Frullania berthoumieui</i> Steph.	Schäfer-Verwimp & Verwimp 16155 (GOET)	Thailand	FJ380724
<i>Frullania depressa</i> Mitt.	Pócs et al. 9217/D (GOET)	Kenya	FJ380797
<i>Frullania dilatata</i> (L.) Dumort.	Hentschel Bryo 0758 (GOET)	Bulgaria	AM384881
<i>Frullania ecklonii</i> (Spreng.) Spreng.	Nöske 1705 (GOET)	Ecuador	FJ380785
<i>Frullania glomerata</i> (Lehm. & Lindenb.) Nees & Mont.	Costa & Gradstein 3839 (GOET)	Brazil	FJ380774
<i>Frullania gracilis</i> (Reinw., Blume & Nees) Dumort.	Schäfer-Verwimp & Verwimp 16158 (GOET)	Thailand	FJ380840
<i>Frullania nodulosa</i> (Reinw., Nees & Blume) Nees	Pócs & Pócs 03271/B (GOET)	Republic of Fiji	FJ380814
<i>Frullania obcordata</i> Lehm. & Lindenb.	Adolf s.n. (GOET)	Brazil	FJ380805
<i>Frullania patula</i> Mitt.	von Konrat 98/43 (GOET)	New Zealand	FJ380728
<i>Frullania ptychantha</i> Mont.	Engel & von Konrat 24353 (GOET)	New Zealand	FJ380807
<i>Frullania reflexistipula</i> Sande Lac.	Lee & Indri 97 (GOET)	Indonesia	FJ380734
<i>Frullania tamarisci</i> (L.) Dumort.	Hentschel Bryo 0733 (GOET)	Germany	AM384880
<i>Frullanoides mexicana</i> Slageren	Burghardt 4421a (GOET)	Mexico	DQ983682
<i>Fulfordianthus evansii</i> (Fulford) Gradst.	Dauphin s.n. (GOET)	Costa Rica	DQ983683
<i>Fuscocephaloziopsis albescens</i> (Hook.) Váña & L. Söderstr.	Schäfer-Verwimp & Verwimp 18194 (GOET)	Austria	KC184742
<i>Fuscocephaloziopsis crassifolia</i> (Lindenb. & Gottsche) Váña & L. Söderstr.	Churchill et al. 21621 (GOET)	Bolivia	KC184711
<i>Gackstroemia magellanica</i> (Lam.) Trevis.	Hyvonen 3079 (H)	Argentina	AY462295
<i>Geocalyx graveolens</i> (Schrud.) Nees	Meinunger s.n. (JE)	Germany	DQ312490
<i>Goebeliella cornigera</i> (Mitt.) Steph.	Glenny 2001 (H)	New Zealand	AY462296
<i>Goebelobryum unguiculatum</i> (Hook. f. & Taylor) Grolle	Qiu et al. NZ-03054 (MICH)	New Zealand	DQ787465
<i>Gongylanthus ericetorum</i> (Raddi) Nees	Duell 63.(35.) (GOET)	Greece	AM392303
<i>Gottschelia schizopleura</i> (Spruce) Grolle	Ah-Peng R96 (GOET)	Madagascar	FJ984940
<i>Gymnomitrium concinnatum</i> (Lightf.) Corda	Davis 424 (DUKE)	Canada	DQ439686

<i>Gyrothya underwoodiana</i> M.Howe	Forrest 593 (ABSH)	Canada	DQ268970
<i>Harpalejeunea grandistipula</i> R.M.Schust.	Schäfer-Verwimp et al. 24289 (GOET)	Ecuador	DQ983685
<i>Harpanthus scutatus</i> (F.Weber & D.Mohr) Spruce	Risk et al. 10341 (DUKE)	USA	DQ787464
<i>Herbertus sendmeri</i> (Nees) A.Evans	Groth s.n. (GOET)	Bolivia	AY699993
<i>Herzogianthus vaginatus</i> (Herzog) R.M.Schust.	Qiu & Braggins NZ-03173 (MICH)	New Zealand	DQ787462
<i>Heteroscyphus aselliformis</i> (Reinw., Blume & Nees) Schiffn.	Gradstein 10240 (GOET)	Indonesia	DQ312493
<i>Heteroscyphus coalitus</i> (Hook.) Schiffn.	Long 30316 (H)	Nepal	AY149844
<i>Heteroscyphus knightii</i> (Steph.) Grolle	Engel & vonKonrat 28206 (H)	New Zealand	HM439103
<i>Hyalolepidozia microphylla</i> R.M.Schust. ex J.J.Engel	Brown 08/301 (NSW)	New Zealand	JF316304
<i>Hygrolembidium acrocladum</i> (Berggr.) R.M.Schust.	Streimann 16733 (H)	Australia	AY462301
<i>Isolombidium anomalum</i> (Rodway) Grolle	Brown 08/286 (NSW)	New Zealand	JF316294
<i>Isotachis japonica</i> Steph.	Matsuda 52 (HIRO)	Japan	AB476569
<i>Jackiella curvata</i> E.A.Hodgs. & Allison	Qiu et al. NZ-03064 (AK, MICH)	New Zealand	DQ787461
<i>Jubula hutchinsiae</i> (Hook.) Dumort.	Drehwald 3007 (GOET)	Portugal	AY548101
<i>Jungermannia atrovirens</i> Dumort.	Hentschel & Heinrichs Bryo 01784 (GOET)	Germany	EF503675
<i>Jungermannia exsertifolia</i> Steph. ssp. <i>cordifolia</i> Váňa	Duncan s.n. (GOET)	USA	EF503676
<i>Jungermannia ovato-trigona</i> (Steph.) Grolle	Gradstein 10007 (GOET)	Colombia	DQ312500
<i>Jungermannia pumila</i> With.	Bakalin P-72-2-05 (GOET)	Russia	EF503677
<i>Kurzia hippuroides</i> (Hook. f. & Taylor) Grolle	NSW709903 (NSW)	Australia	EF100997
<i>Kurzia trichoclados</i> (Müll. Frib.) Grolle	Rothero 11014 (E)	United Kingdom	JF316319
<i>Kymatocalyx dominicensis</i> (Spruce) Váňa	Schäfer-Verwimp & Verwimp 22451 (GOET)	Guadeloupe	KC184726
<i>Leiocolea heterocolpos</i> (Thed.) H.Buch	Stotler & Crandall-Stotler 4357 (ABSH)	USA	DQ268972
<i>Leiomitra lanata</i> (Hook.) R.M.Schust.	Glenny 8521 (CHR)	New Zealand	AY462305
<i>Lejeunea cancellata</i> Nees & Mont. ex Mont.	Wilson et al. 04-02 (GOET)	Ecuador	DQ983686
<i>Lejeunea catinulifera</i> Spruce	Wilson et al. 04-01 (GOET)	Ecuador	DQ983687
<i>Lejeunea cavifolia</i> (Ehrh.) Lindb.	Heinrichs 3695 (GOET)	Germany	AY548102
<i>Lejeunea eckloniana</i> Lindenb.	Schäfer-Verwimp & Verwimp 24788 (GOET)	Spain	DQ983690
<i>Lejeunea flava</i> (Sw.) Nees	Gradstein s.n. (GOET)	Brazil	DQ983692
<i>Lejeunea laetevirens</i> Nees & Mont.	Schäfer-Verwimp & Verwimp 17899 (GOET)	Dominica	AY548103
<i>Lejeunea mimula</i> Hürl.	Schäfer-Verwimp & Verwimp 20930 (GOET)	Indonesia	AY548104
<i>Lejeunea paucidentata</i> (Steph.) Grolle	Schäfer-Verwimp & Verwimp 17737 (GOET)	Dominica	DQ983695
<i>Lembidium nutans</i> (Hook. f. & Taylor) Mitt. ex A.Evans	NSW493343 (NSW)	New Zealand	EF100992
<i>Lepicolea attenuata</i> (Mitt.) Steph.	Stotler & Crandall-Stotler 4586 (ABSH)	New Zealand	AY507410
<i>Lepicolea pruinosa</i> (Taylor) Spruce	Schäfer-Verwimp et al. 24205 (GOET)	Ecuador	AM392314
<i>Lepidogyna hodgsoniae</i> (Grolle) R.M.Schust.	Frey & Pfeiffer 98-T 68 B (BSB)	New Zealand	DQ645968
<i>Lepidolaena clavigera</i> (Hook.) Dumort. ex Trevis.	Curnow 5079 (H)	New Zealand	AY462309
<i>Lepidolejeunea eluta</i> (Nees) R.M.Schust.	Churchill & Vasquez 2180 (GOET)	Bolivia	AY548066
<i>Lepidozia glaucophylla</i> (Hook. f. & Taylor) Gottsche, Lindenb. & Nees	NSW722420 (NSW)	Australia	EF100999
<i>Lepidozia spinosissima</i> (Hook. f. & Taylor) Mitt.	NSW712837 (NSW)	New Zealand	EF101002
<i>Lepidozia ulothrix</i> (Schwägr.) Lindenb.	NSW708080 (NSW)	New Zealand	EF101004
<i>Leptolejeunea elliptica</i> (Lehm. & Lindenb.) Schiffn.	Matsuda 30 (HIRO)	Japan	AB476575
<i>Leptoscyphus autoicus</i> (J.J.Engel & Gradst.) Vanderp. & Gradst.	Gradstein & Nöske 10090 (GOET)	Ecuador	DQ312511
<i>Leptoscyphus jackii</i> (Steph.) Grolle	Schäfer-Verwimp et al. 24296 (GOET)	Ecuador	DQ312504
<i>Lethocolea naruto-toganensis</i> Furuki	Furuki 18022 (HIRO)	Japan	AB476576
<i>Cheilolejeunea xanthocarpa</i> (Lehm. & Lindenb.) Malombe	Costa & Gradstein 3839 (GOET)	Brazil	DQ983700
<i>Lindigianthus cipaconeus</i> (Gottsche) Kruijt & Gradst.	Kottke & Preußing MPEO2390 (GOET)	Ecuador	DQ983702
<i>Liochlaena lanceolata</i> Nees	Stotler & Crandall-Stotler 107 (ABSH)	USA	AY507409
<i>Lopholejeunea eulopha</i> (Taylor) Schiffn.	Pócs & Streimann 9987/H (GOET)	Australia	AY548067
<i>Lopholejeunea subfusca</i> (Nees) Schiffn.	Gradstein et al. 10368 (GOET)	Malaysia	DQ983705
<i>Lophozia ascendens</i> (Warnst.) R.M.Schust.	Klama et al. 171 (GOET)	Poland	KC184727
<i>Lophozia lantratoviae</i> Bakalin	Bakalin P-72-19-05 (GOET)	Russia	KC184728
<i>Lophozioipsis excisa</i> (Dicks.) Konstant. & Vilnet	Bakalin P-74-17-05 (GOET)	Russia	KC184729

<i>Lophozioipsis longidens</i> (Lindb.) Konstant. & Vilnet	Bakalin 65 (GOET)	Russia	KC184730
<i>Macrocolura sagittistipula</i> (Spruce) R.M.Schust.	Schäfer-Verwimp & Verwimp 18014 (GOET)	Dominica	DQ983707
<i>Marchesinia robusta</i> (Mitt.) Schiffn.	Wilson et al. 04-05 (GOET)	Ecuador	DQ983710
<i>Marsupella emarginata</i> (Ehrh.) Dumort.	Qiu 99077 (Z)	?	DQ645972
<i>Marsupidium latifolium</i> R.M.Schust.	Dauphin 2920 (NY)	Costa Rica	AY608034
<i>Mastigolejeunea auriculata</i> (Wilson & Hook.) Schiffn.	Schäfer-Verwimp & Verwimp 20780 (GOET)	Indonesia	AY548071
<i>Mastigophora diclados</i> (Brid. ex F.Weber) Nees	Schäfer-Verwimp & Verwimp 24898 (GOET)	Indonesia	EF503679
<i>Metacalypogeia cordifolia</i> (Steph.) Inoue	Furuki 21344 (HIRO)	Japan	AB476580
<i>Mnioloma fuscum</i> (Lehm.) R.M.Schust.	Masuzaki 918 (HIRO)	Malaysia	AB476585
<i>Mylia verrucosa</i> Lindb.	Masuzaki 1344 (HIRO)	Japan	AB476587
<i>Myriocolea irrorata</i> Spruce	Gradstein et al. 10033B (GOET)	Ecuador	AY548073
<i>Myriocoleopsis gymnocolea</i> (Spruce) M.E.Reiner & Gradst.	Gradstein et al. 10020 (GOET)	Ecuador	DQ238568
<i>Nardia succulenta</i> (Rich. ex Lehm. & Lindenb.) Spreng.	Churchill et al. 22796 (GOET)	Bolivia	EF503681
<i>Neesioscaphus bicuspidatus</i> (Steph.) Grolle	Dauphin 2042 (H)	Costa Rica	DQ354978
<i>Neoorthocaulis floerkei</i> (F.Weber & D.Mohr) L.Söderstr., De Roo & Hedd.	Drehwald s.n. (GOET)	Germany	KC184734
<i>Neotrichocolea bisseti</i> (Mitt.) S.Hatt.	He 040522 (PE)	China	EF460702
<i>Neurolejeunea breutelii</i> (Gottsche) A.Evans	Gradstein & Costa 3871 (GOET)	Brazil	DQ983713
<i>Nipponolejeunea subalpina</i> (Horik.) S.Hatt.	Ohnishi 5611 (HIRO)	Japan	AM392292
<i>Nothogymnomitrium erosum</i> (Carrington & Pearson) R.M.Schust.	Streimann 53475 (JE)	Australia	GQ900318
<i>Notoscaphus lutescens</i> (Lehm. & Lindenb.) Mitt.	Pócs et al. 98101/D (GOET)	Vietnam	EF503682
<i>Nowellia dominicensis</i> Steph.	Schäfer-Verwimp & Verwimp 17954/A (GOET)	Dominica	KC184735
<i>Odontolejeunea lunulata</i> (F. Weber) Schiffn.	Piippo s.n. (H)	Costa Rica	AY302456
<i>Odontoschisma falcifolium</i> Steph.	Gradstein 8535 (GOET)	Colombia	KC184739
<i>Odontoschisma fluitans</i> (Nees) L.Söderstr. & Váňa	Heinrichs et al. 2058 (GOET)	Germany	KC184721
<i>Omphalanthus filiformis</i> (Sw.) Nees	Drehwald 4462 (GOET)	Bolivia	AY548074
<i>Pedinophyllum interruptum</i> (Nees) Kaal.	Heinrichs et al. 4701 (GOET)	Germany	GU593095
<i>Phaeolejeunea amicomum</i> (Hürl.) Pócs	Pócs 03304L (EGR)	Republic of Fiji	DQ983718
<i>Physantholejeunea portoricensis</i> (Hampe & Gottsche) R.M.Schust.	Schäfer-Verwimp & Verwimp 22615 (GOET)	Guadeloupe	DQ983719
<i>Plagiochila alternans</i> Lindenb. & Gottsche	Heinrichs et al. 4178 (GOET)	Bolivia	AY699995
<i>Plagiochila asplenoides</i> (L.) Dumort.	Heinrichs & Groth 4339 (GOET)	Germany	AY699996
<i>Plagiochila cucullifolia</i> J.B.Jack & Steph.	Holz 558 E/5-01	Ecuador	DQ194126
<i>Plagiochila diversifolia</i> Lindenb. & Gottsche	Holz 017 E/5-01	Ecuador	DQ194131
<i>Plagiochila dura</i> De Not.	Drehwald 3190 (GOET)	Chile	DQ194133
<i>Plagiochila dusenii</i> Steph.	Holz 146 (GOET)	Argentina	DQ194135
<i>Plagiochila frondescens</i> (Nees) Lindenb.	Schäfer-Verwimp & Verwimp 20704 (GOET)	Indonesia	DQ194141
<i>Plagiochila fruticosa</i> Mitt.	Deguchi s.n. (GOET)	Japan	DQ194142
<i>Plagiochila fusca</i> Sande Lac.	Gradstein 10259 (GOET)	Indonesia	DQ194143
<i>Plagiochila integerrima</i> Steph.	O'Shea M7552a (GOET)	Malawi	DQ194095
<i>Plagiochila montagnei</i> Nees	Groth s.n. (GOET)	Bolivia	DQ194164
<i>Plagiochila peculiaris</i> Schiffn.	Long 28832 (E)	Bhutan	DQ194176
<i>Plagiochila punctata</i> (Taylor) Taylor	Rycroft 01013 (GOET)	United Kingdom	DQ194180
<i>Plagiochila rubescens</i> (Lehm. & Lindenb.) Lindenb.	Rycroft 020723-6 (GOET)	Chile	DQ194187
<i>Plagiochila rutilans</i> Lindenb.	Groth 101 (GOET)	Bolivia	DQ194189
<i>Plagiochila sandei</i> Dozy ex Sande Lac.	Gradstein 9970 (GOET)	Indonesia	DQ194191
<i>Plagiochila sciophila</i> Nees	Ohnishi 5400 (HIRO)	Japan	DQ194193
<i>Plagiochila semidecurrens</i> (Lehm. & Lindenb.) Lehm. & Lindenb.	Long 21348 (E)	Nepal	DQ194194
<i>Plagiochilium mayebarae</i> S.Hatt.	Onishi 5588 (HIRO)	Japan	AY699999
<i>Microlejeunea squarrosa</i> (Steph.) Heinrichs, Schäf.-Verw., Pócs & S.Dong	Schäfer-Verwimp & Verwimp 13376 (GOET)	Brazil	DQ983720
<i>Porella cordaeana</i> (Huebener) Moore	Long 34092 (E)	United Kingdom	EF545286
<i>Porella nitens</i> (Steph.) S.Hatt.	Long 34415 (E)	China	EF545339
<i>Porella obtusata</i> (Taylor) Trevis.	Schäfer-Verwimp & Verwimp 24754 (GOET)	Spain	EF545349
<i>Pseudocephalozia lepidozoides</i> R.M.Schust.	Brown 08/216 (NSW)	New Zealand	JF316289
<i>Pseudomarsupidium decipiens</i> (Hook.) Grolle	Wigginton 05/613 (GOET)	United Kingdom	FJ984934

<i>Psiloclada clandestina</i> Mitt.	NSW611373 (NSW)	New Caledonia	EF101007
<i>Prilidium ciliare</i> (L.) Hampe	Hentschel Bryo 01602 (GOET)	Germany	AM392297
<i>Ptychanthus striatus</i> (Lehm. & Lindenb.) Nees	Deguchi 36758 (GOET)	Japan	DQ983722
<i>Pycnolejeunea densistipula</i> (Lehm. & Lindenb.) Steph.	Schäfer-Verwimp 23368 (GOET)	Ecuador	AY548075
<i>Radula complanata</i> (L.) Dumort.	Heinrichs 1712 (GOET)	Austria	KJ508346
<i>Radula frondescens</i> Steph.	Holz CR 00-774B (GOET)	Costa Rica	AM392291
<i>Radula javanica</i> Gottsche	Holz FG 00-62 (GOET)	French Guiana	AM392290
<i>Radula kojana</i> Steph.	Tsubota 5932 (HIRO)	Japan	AB476595
<i>Radula striata</i> Mitt. ex Steph.	Drehwald DB34326 (GOET)	Chile	KJ508345
<i>Rectolejeunea berteroa</i> (Gottsche ex Steph.) A.Evans	Schäfer-Verwimp & Verwimp 22245/A (GOET)	Guadeloupe	DQ983724
<i>Saccogyna viticulosa</i> (L.) Dumort.	Gradstein 9977 (GOET)	Spain	DQ312514
<i>Saccogynidium goebelii</i> (Herzog) Grolle	Schäfer-Verwimp & Verwimp 24874 (GOET)	Indonesia	EF503683
<i>Scapania ampliata</i> Steph.	Yokoyama 11576 (GOET)	Japan	KC184744
<i>Scapania aspera</i> M.Bernet & Bernet	Hentschel Bryo 0762 (GOET)	Bulgaria	AM392310
<i>Scapania javanica</i> Gottsche	Schäfer-Verwimp & Verwimp 16900 (GOET)	Indonesia	KC184750
<i>Scapania paludosa</i> (Müll. Frib.) Müll.Frib.	Schäfer-Verwimp & Verwimp 19613 (GOET)	Germany	KC184753
<i>Scapania portoricensis</i> Hampe & Gottsche	Churchill 24297 (GOET)	Ecuador	KC184754
<i>Schiffneria hyalina</i> Steph.	Schäfer-Verwimp & Verwimp 24869 (GOET)	Indonesia	KC184759
<i>Schiffneriolejeunea parviloba</i> (Steph.) Gradst.	Schäfer-Verwimp & Verwimp 20314 (GOET)	Réunion	AY548076
<i>Schistochila acuminata</i> Steph.	Schäfer-Verwimp & Verwimp 25281 (GOET)	Indonesia	AM392299
<i>Schistochila aligera</i> (Nees & Blume) J.B.Jack & Steph.	Gradstein 10406 (GOET)	Malaysia	AM392300
<i>Schistochilopsis incisa</i> (Schrad.) Konstant.	Hentschel & Wilson Bryo 01593 (GOET)	Germany	AM392308
<i>Siphonolejeunea elegantissima</i> (Steph.) Grolle	Pócs & Brown 0026/A,A (EGER)	Australia	DQ983726
<i>Solenostoma infusca</i> (Mitt.) Hentschel	Deguchi s.n. (GOET)	Japan	DQ312498
<i>Sphenobolus minutus</i> (Schreb.) Berggr.	Hentschel Bryo 0421 (GOET)	Norway	DQ312475
<i>Spruceanthus theobromae</i> (Spruce) Gradst.	Andersson & Kautz AK10 (GOET)	Ecuador	DQ983727
<i>Stictolejeunea squamata</i> (Willd. ex F.Weber) Schiffn.	Dauphin 2134 (GOET)	Costa Rica	DQ983728
<i>Symbiezidium barbiflorum</i> (Lindenb. & Gottsche) A.Evans	Gradstein & Dauphin 9363 (GOET)	Costa Rica	DQ983729
<i>Symbiezidium transversale</i> (Sw.) Trevis.	Gradstein 9924 (GOET)	Bolivia	AY548079
<i>Syzygiella anomala</i> (Lindenb. & Gottsche) Steph.	Heinrichs et al. K4 (GOET)	Ecuador	GQ900328
<i>Syzygiella perfoliata</i> (Sw.) Spruce	Gradstein 3888 (GOET)	Brazil	GQ900353
<i>Telaranea wallichiana</i> (Gottsche) R.M.Schust.	Brown 04/829 (NSW)	Papua New Guinea	JF316328
<i>Temnoma pilosum</i> (A.Evans) R.M.Schust.	Hyvoenen 5084 (H)	Chile	AY462330
<i>Tetracymbaliella cymbalifera</i> (Hook. f. & Taylor) Grolle	Pócs et al. 90066/F (H)	Tanzania	DQ026591
<i>Tetralophozia pilifera</i> (Steph.) R.M.Schust.	Gradstein 11015 (GOET)	Indonesia	KC184763
<i>Thysananthus comosus</i> Lindenb. ex Lehm.	Gradstein et al. 10366 (GOET)	Malaysia	DQ983736
<i>Triandrophyllum subtrifidum</i> (Hook. & Taylor) Fulford & Hatcher	Schäfer-Verwimp et al. 24436 (GOET)	Ecuador	AM392315
<i>Trichocolea pluma</i> Dumort.	Masuzaki 776 (HIRO)	Japan	AB476603
<i>Trichocoleopsis sacculata</i> (Mitt.) S.Okamura	Liu 4170 (PE)	China	EF460701
<i>Tricholepidozia plumulosa</i> (Lehm. & Lindenb.) E.D.Cooper	Engel 26422 (F)	Chile	JF316312
<i>Trichotemnoma currugatum</i> (Steph.) R.M.Schust.	Glenny 8426 (CHR)	New Zealand	AY462333
<i>Tritomaria exsecta</i> (Schmidel ex Schrad.) Schiffn. ex Loeske	Schäfer-Verwimp & Verwimp 21816 (GOET)	Russia	KC184765
<i>Tylimanthus laxus</i> (Lindenb.) Steph.	Holz CR-00-0197 (GOET)	Costa Rica	AY700004
<i>Acrobolbus saccatus</i> (Hook.) Trevis.	Qiu 02044; Frey & Pfeiffer 98-Mo 41 A (BSB)	New Zealand	DQ645975
<i>Vetaforma dusenii</i> (Steph.) Fulford & J.Taylor	Engel 11423 (C)	Chile	AY462335
<i>Wettsteinia inversa</i> (Sande Lac.) Schiffn.	Gradstein 11014 (GOET)	Indonesia	FJ984935
<i>Xylolejeunea crenata</i> (Mont.) X.-L.He & Grolle	Schäfer-Verwimp & Verwimp 11225 (GOET)	Brazil	DQ983740
<i>Zoopsisidella caledonica</i> (Steph.) R.M.Schust.	NSW611654 (NSW)	New Caledonia	EF101022
<i>Zoopsis leitgebiana</i> (Carrington & Pearson) Bastow	NSW614795 (NSW)	Australia	EF101023