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Supplemental Information

**A phylogenomically informed five-order
system for the closest relatives of land plants**

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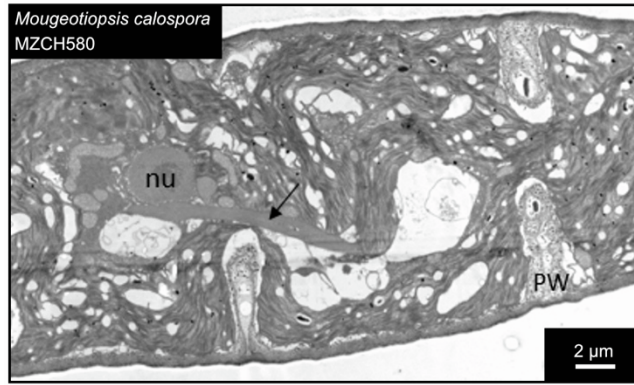


Figure S1: Macrotubule formation as detected in TEM sections of *Mougeotiopsis calospora* cells with incomplete cytokinesis, related to Figure 1. Overview showing three cells with incomplete cytokinesis and partial cross walls. Arrow indicates bundle of macrotubules.

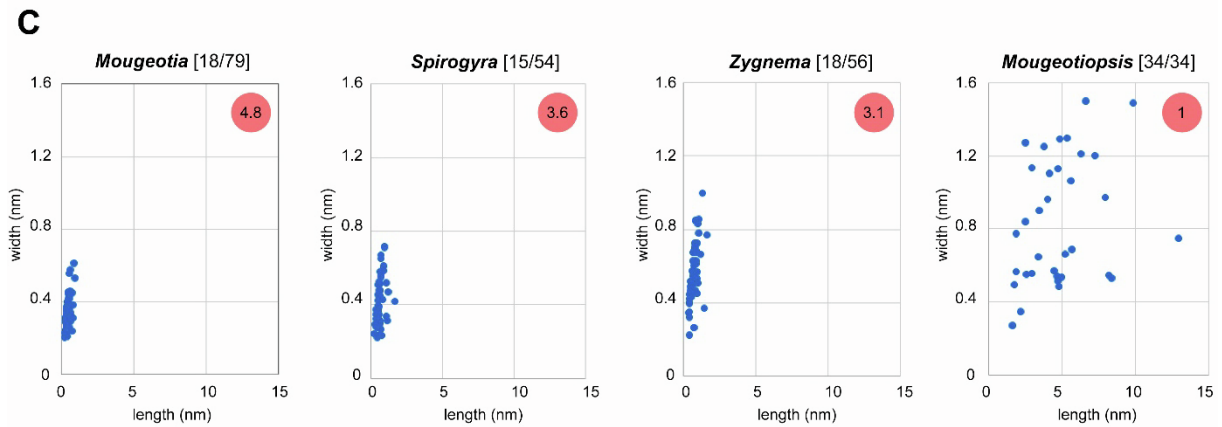
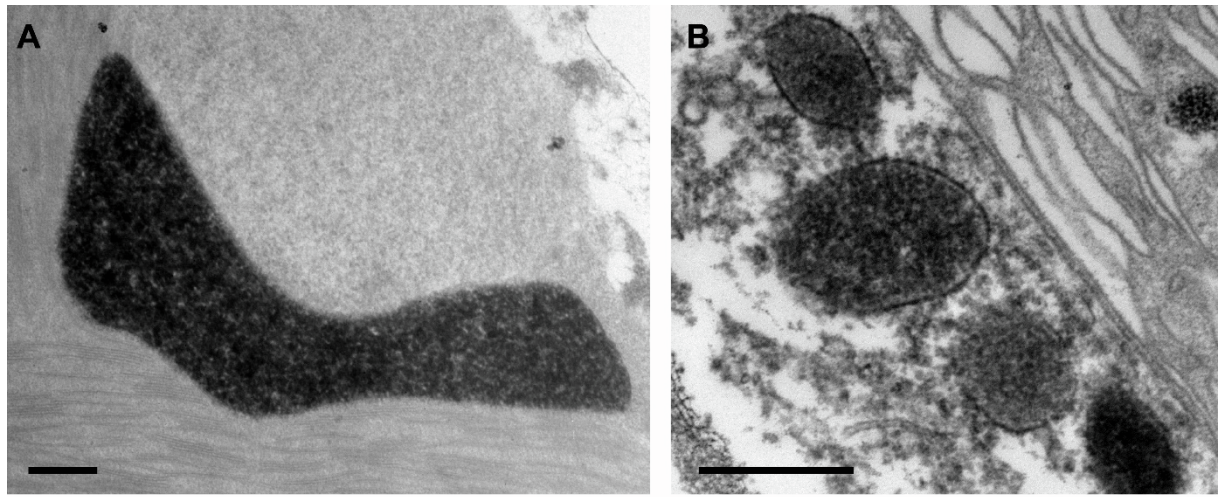


Figure S2: Peroxisomes of filamentous zygmatophytes, related to Figure 1. **A:** Transmission electron micrograph of a DAB-stained peroxisome of *Mougeotiopsis calospora*, strain MZCH580. **B:** Transmission electron micrograph of DAB-stained peroxisomes of *Mougeotia* sp., strain MZCH240. **C:** Sizes of peroxisome sections of four filamentous zygmatophytes as measured in transmission electron micrographs. The number of analysed cells/peroxisomes are shown in square brackets, and the average number of peroxisome cross sections per cell in the red circles. Scale bars, 0.5 μm .

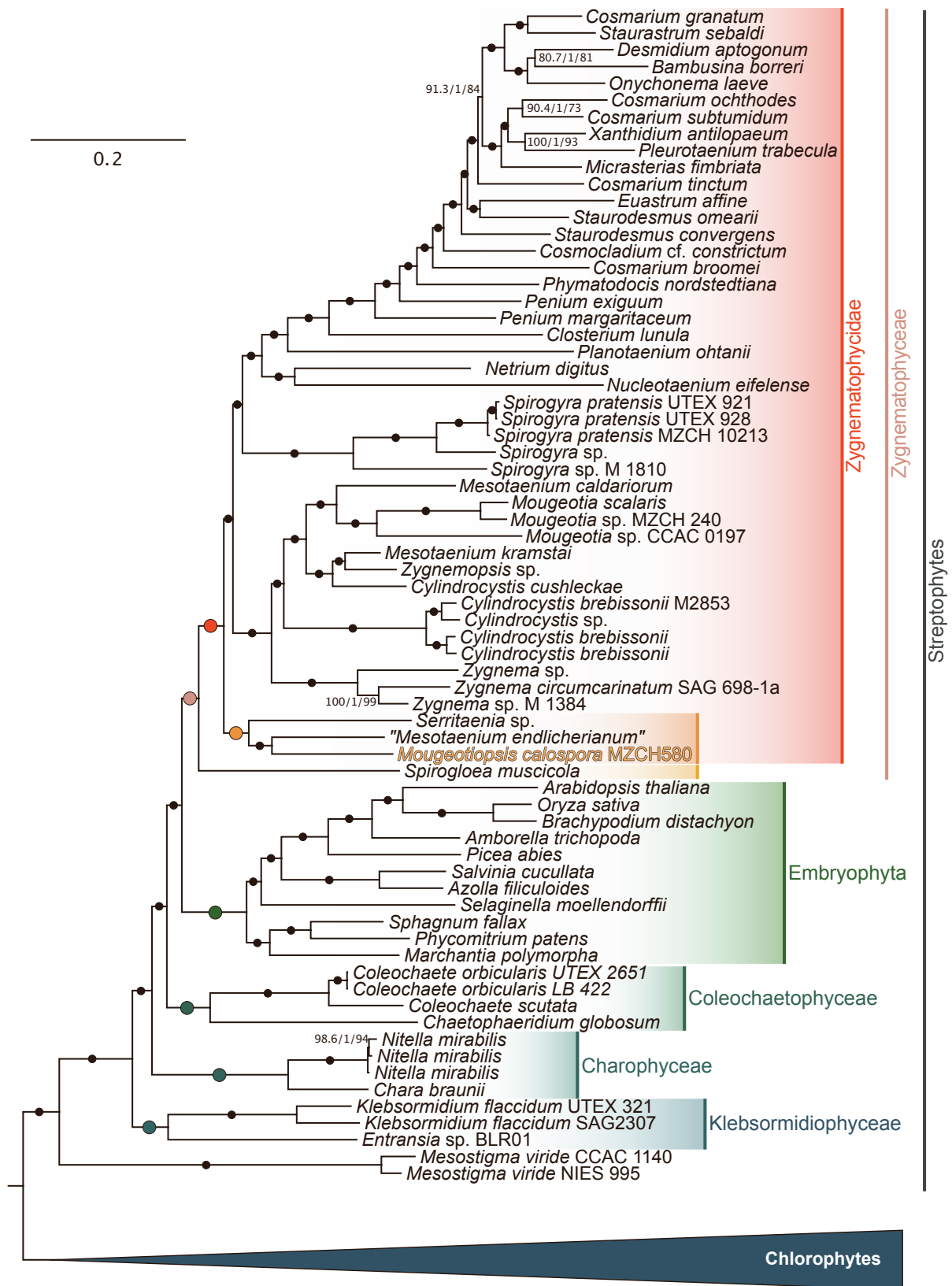


Figure S3: Multigene phylogeny of 84 Viridiplantae, related to Figure 2. Phylogenomic tree that shows the relationship of all streptophyte species analysed; the tree was rooted with the clade of chlorophytes. Scale bar, 0.2 substitutions per site. Support values from three analyses (SH-aLRT/aBayes/nonparametric bootstrapping) are shown at the corresponding branches, except for branches with maximum support (marked by dots); colored dots correspond to the (full) support recovered for the higher-order clades labeled on the right.

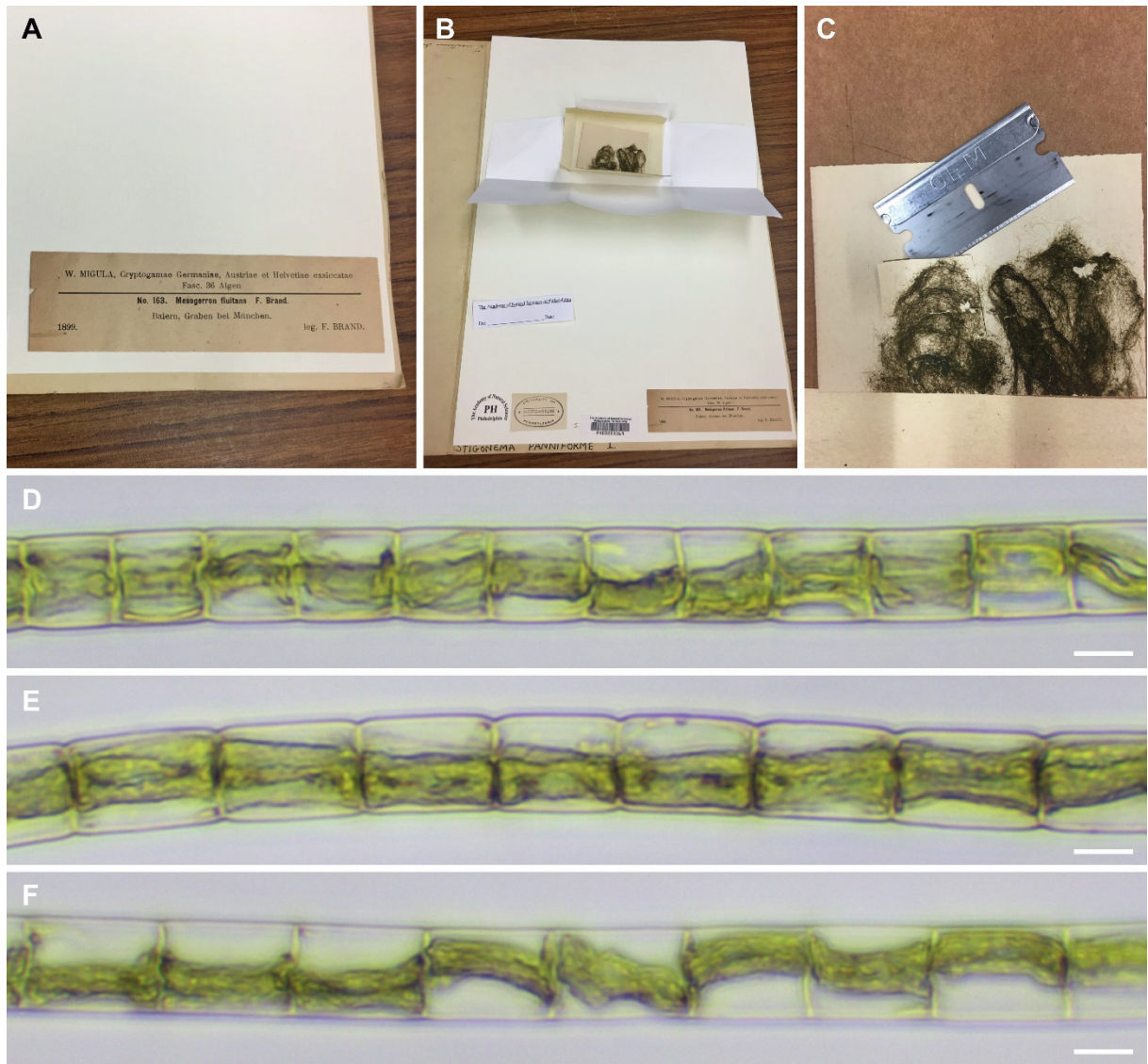


Figure S4: Destructive sampling of *Mesogerron fluitans* collected by Brand and morphological characteristics of the material, related to Figure 1. A and B: Specimen in the Herbarium of the Academy of Natural Sciences of Philadelphia (PH). C: Removal of dried algal material. D–F: Rehydrated algal filaments of the sample. Note the varying cell length and the chloroplast morphology resembling that of strain MZCH580. Images in A–C: courtesy of Richard McCourt. Scale bars, 10 μm.