Species delimitation, hybridization and species habitat associations in the genus Symphonia (Clusiacea) on Madagascar

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Tropical rainforest tree genera often comprise multiple closely-related species occurring in sympatry but the genetic mechanisms that explain such sympatric coexistence are poorly understood. Inter-specific hybridization has been proposed as a key mechanism in the maintenance of highly diverse communities, potentially retarding the (local) extinction of rare species and also allowing the sharing of beneficial genetic variants across species borders. The genus Symphonia (Clusiaceae) diversified on Madagascar, where ca. 20 endemic species have largely overlapping ranges. Symphonia species are difficult to distinguish morphologically because of trait variation within species, poorly defined species boundaries and scarcity of discriminant characters for species delimitation.

We set out to test the role of hybridization in shaping patterns of genetic variation and species delimitation of the genus Symphonia in Madagascar. We sampled over 400 trees from three regions in eastern Madagascar, where hybridization among multiple species of the genus is expected to take place, genotyped them at 20 nuclear SSRs (nuSSRs), as well as sequenced the internal transcribed spacer (ITS) region in a representative subsample. A phylogeny was built from ITS sequences and we used genetic clustering approaches on “blind samples” (i.e., without using morphology) for taxon delimitation using nuSSRs. We then examined the spatial distribution of genetic clusters and assessed the hybridization history of the genus in Madagascar.

We discovered three major gene pools in Symphonia, which were sub-structured into 13 minor gene pools that could be assigned to 13 potential species. Gene pools occurred frequently in sympatry, suggesting a role of hybridization in maintaining high genetic diversity in the genus. Flow cytometry and nuSSR scoring identified three tetraploid and ten diploid species. Clustering analysis was congruent with morphological characters in S. clusioides, S. eugenioides, S. microphylla, and S. nectarifera, but did not support other described taxa such as S. fasciculata, S. sessiliflora and S. louvelii. Overall, we found evidence for hybridization and introgression between multiple species and a habitat-specific distribution of sympatric clusters in several locations.