The dynamics of selfish self-splicing introns in mitochondrial genomes of *Epichloë* endophytes

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The genus *Epichloë* consists of fungal endophytes that have co-evolved with many Pooideae grass species. *Epichloë* species display variability in endophytic lifestyle and the propensity to hybridise, and these features make them an interesting group to study the dynamics of selfish elements. Self-splicing group I and II introns, selfish genetic elements that are widely yet patchily distributed across the tree of life, are found in *Epichloë* species, particularly in their mitochondrial genomes. These introns are considered selfish as they display super-Mendelian inheritance as a result of processes, collectively termed 'homing', that allow them to rapidly spread, both within and between populations, into the specific genomic sites they occupy. This study found that the mitochondrial genomes of *Epichloë* species contain a wide variety of group I and group II self-splicing introns, but these introns show substantial presence-absence polymorphism. Strikingly, the distribution of these introns does not correlate with the known phylogeny of *Epichloë*, nor does it correlate with *Epichloë* sexuality/asexuality or hybridity. Moreover, phylogenies made using *Epichloë* mitochondrial genomes do not correlate with those made using nuclear genes. This study showed that the best explanation for the distribution of these self-splicing introns is ongoing invasions and losses over the course of *Epichloë* evolution. Unexpectedly, however, little evidence was found for the extensive intron degradation that the current self-splicing intron model predicts should occur prior to complete intron loss. Instead, results suggest *Epichloë* mitochondrial self-splicing introns are rapidly lost following their fixation. However, analysis suggests that additional factors, such as the evolution of homing suppressors, likely contribute to *Epichloë* self-splicing intron dynamics. Collectively, the results from this study show that self-splicing introns have more diverse evolutionary dynamics than previously appreciated. However, the results also present a conundrum as they suggest there has been relatively frequent exchange of mitochondrial introns between these endophytic *Epichloë* lineages over the course of genus evolution. The nature of these exchanges and whether they underlie the inconsistency between mitochondrial and nuclear *Epichloë* phylogenies are unknown and deserve further attention.

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