Separate introns gained within short and long soluble peridinin-chlorophyll *a*-protein genes during radiation of *Symbiodinium* (Dinophyceae) clade A and B lineages

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Abstract

Here we document introns in two *Symbiodinium* clades that were most likely gained following divergence of this genus from other peridinin-containing dinoflagellate lineages. Soluble peridinin-chlorophyll a-proteins (sPCP) occur in short and long forms in different species, and all short and long *sPCP* genes characterized to date are intronless. However, we observed that long *sPCP* genes from two Caribbean *Symbiodinium* clade B isolates each contained two introns. To test the hypothesis that introns were gained during radiation of clade B, we compared *sPCP* genomic and cDNA sequences from 13 additional distinct Caribbean and Pacific *Symbiodinium* clade A, B, and F isolates. Long *sPCP* genes from all clade B/B1and B/B19 descendants contain orthologs of both introns. Short *sPCP* genes from *S. pilosum* (A/A2) and *S. muscatinei* (B/B4) plus long *sPCP* genes from *S. microadriaticum* (A/A1) and *S. kawagutii* (F/F1) are intronless. Short *sPCP* genes of *S. microadriaticum* have a third unique intron. *Symbiodinium* clade B long *sPCP* sequences are useful for assessing divergence among B1 and B19 descendants. Phylogenetic analyses of coding sequences from four dinoflagellate orders indicate that introns were gained independently during radiation of *Symbiodinium* clades A and B. Long *sPCP* introns were present in the most recent common ancestor of *Symbiodinium* clade B core types B1 and B19 and predate Caribbean expansion of clade B. Timing of short *sPCP* intron gain in *Symbiodinium* clade A is less certain. All *sPCP* introns were gained after fusion of ancestral short *sPCP* genes, which we confirm as occurring once in dinoflagellate evolution.