Molecular phylogeny of tribe Schismatoglottideae (Araceae) based on two plastid markers and recognition of a new tribe, Philonotieae, from the neotropics

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Abstract Tribe Schismatoglottideae comprises one large genus, *Schismatoglottis*, and six small 'satellite' genera. A combined molecular phylogenetic analysis of *matK*, the 3′ portion of the *trnK* intron, and *trnL-F* sequence data was carried out on 77 taxa representing all genera in the tribe, all informal groups in *Schismatoglottis*, together with sister tribe Cryptocoryneae, and outgroups from Araceae. Analyses of combined datasets with parsimony, maximum likelihood, and Bayesian methods revealed tribe Schismatoglottideae to be a polyphyletic assemblage. Neotropical *Schismatoglottis* is shown to be sister to the palaeotropical Schismatoglottideae + Cryptocoryneae. *Schismatoglottis acuminatissima* is a sister clade to the rest of the Schismatoglottideae. Palaeotropical *Schismatoglottis* is unsupported as a monophyletic genus. A new neotropical tribe of Araceae, Philonotieae S.Y. Wong & P.C. Boyce, sister to Cryptocoryneae + palaeotropical Schismatoglottideae, is proposed.

Keywords Araceae; molecular systematics; Philonotieae; Schismatoglottideae; taxonomy

INTRODUCTION

The Araceae are predominantly tropical in distribution, with 90% of 110 genera, and 95% of ca. 4000 species restricted to the everwet or perhumid tropics. Tribe Schismatoglottideae (Aroideae) with ca. 150 species is almost 95% endemic to Borneo. The tribe consists of mainly mesophytes, rheophytes, lithophytes and chasmophytes. The largest genus in the tribe, *Schismatoglottis* Zoll. & Moritzi, extends from Myanmar (Burma) to Vanuatu and from southern subtropical China to New Guinea, with an additional three species in the neotropics. The tribe also includes six small 'satellite' genera: *Aridarum* Ridl., *Bakoa* P.C. Boyce & S.Y. Wong, *Bucephalandra* Schott, *Phymatarum* M. Hotta, *Piptospatha* N.E. Br., and *Schottarum* P.C. Boyce & S.Y. Wong, all, with the exception of *Piptospatha*, endemic to Borneo.

Recent and on-going research on Schismatoglottideae (Okada & al., 1999; Bogner & Hay, 2000; Hay & Yuzammi, 2000; Hay, 2002; Hay & Herscovitch, 2003; Boyce & Wong, 2006, 2008; Wong & Boyce, 2007, 2008; Bogner & Boyce, 2009; Wong & al., 2009), has provided a stable species platform from which to test hypotheses of infra-tribal and intergeneric phylogenetic relationships.

Previous molecular phylogenetic studies focused on family-wide analyses of Araceae and only included two or three taxa from Schismatoglottideae. Barabé & al. (2004) indicated that Schismatoglottideae are not monophyletic but form a monophyletic clade with *Cryptocoryne balansae* Gagnep. Cabrera & al. (2008) maintained Schismatoglottideae and Cryptocoryneae as monophyletic. However, the neotropical *Schismatoglottis* was not included in the analysis. The objectives of the current research are to produce an established and testable phylogeny for the tribe Schismatoglottideae using two plastid markers (*trnL-F*, *matK*) and to resolve the internal topology of *Schismatoglottis* and the currently recognized satellite genera.

MATERIALS AND METHODS

Sampling. — 71 samples were newly sequenced (65 taxa from Schismatoglottideae, 3 from Cryptocoryneae, 3 from other Araceae) and analyzed together with 6 samples obtained from GenBank (Appendix). The samples represent each taxonomic group (sensu Hay & Yuzammi, 2000) of *Schismatoglottis*: Calyptrata Group (4 taxa), Multiflora Group (28 samples representing 16 taxa), Tecturata Group (4 samples representing 3 taxa), Asperata Group (6 taxa), Corneri Group (2 samples of 1 taxon), and Rupestris Group (1 taxon) and one neotropical taxon (*Schismatoglottis americana*). The satellite genera sampled follow the generic taxonomy of Bogner & Hay (2000): *Aridarum* sect. *Aridarum* (3 taxa), and *A.* sect. *Caulescentia* (5 samples representing 3 taxa), *Bakoa* (1 taxon), *Bucephalandra* (one species sampled from two localities), *Phymatarum* (one taxon, sampled from two localities), *Piptospatha* Elongata Group (4 taxa), and Grabowskii Group (2 samples representing 1 taxon), and *Schottarum* (1 taxon). Six taxa from the tribe Cryptocoryneae were sampled: *Cryptocoryne balansae* Gagnep.,