

RESEARCH PAPER

Floral biology of *Scaphochlamys* (Zingiberaceae) focusing on Bornean taxa

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An overview of the floral biology including floral odour analyses of twenty-two Bornean *Scaphochlamys* taxa and three ex Bornean *Scaphochlamys* taxa was undertaken. All *Scaphochlamys* species investigated bloom diurnally. Pollen is released gradually, either simultaneously with stigma secretion or later (mostly within one hour). Flowers of most *Scaphochlamys* species were found to emit a mild odour but a few are odourless. Stigmas and anther spurs (where present) differ among the taxa investigated. Natural fruit set percentages of all species investigated were very low, up to 14.29%. *Scaphochlamys* species are facultatively xenogamic as the pollen/ovule ratios (P/O ratios) were high. Analysis of floral odour revealed 102 identifiable floral volatile organic compounds (VOCs), representing 31.8% of the compounds found. The volatile fraction was characterized by the aliphatics class (21.5%), monoterpenes (3.4%), irregular terpenes (0.3%) and benzenoids and phenyl propenoids (0.6%). Two pollinator guilds were found: halictid bees and *Amegilla* bees.

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1 Background

Zingiberaceae are the largest family in the order Zingiberales comprising 56 to 62 genera and over 1,370 species (Stevens 2001 onwards; de Boer et al. 2018). The family has a pan-tropical distribution, with its centre of diversity in the Malesian biogeographic region (Kress et al. 2002; Larsen 2005). In Borneo, the gingers display great diversity and are separated into 23 genera with nearly 270 described taxa (Lamb et al. 2013; Ooi et al. 2017; de Boer et al. 2018).

Scaphochlamys Baker is a genus of 54 species in the *Kaempferia* Clade (*sensu* Kress et al. 2002)

occurring from southern Thailand through Peninsular Malaysia and Sumatera, to northern Borneo (Ooi et al. 2017). *Borneocola* Y.Y. Sam and *Myxochlamys* A. Takano & Nagam. together are sister to the remainder of *Scaphochlamys*. However, recognition of these as genera renders *Scaphochlamys* impossible to define morphologically. The clade is sister to *Distichochlamys* M.F. Newman (Takano & Nagamasu 2007; Sam et al. 2016). *Scaphochlamys* is distinguished from *Myxochlamys* and *Distichochlamys* by the following combination of characters: petiole base pulvinate (Borneo only), spiral floral bract arrangement, flowering acroscopic, first bracteole 2-keeled and arising opposite to the bract, bracteole split to the base and anthers with free basal spurs (Searle 2010). Twenty-four *Scaphochlamys* species are currently recognized in Borneo, all of them endemic. The Bornean species have been classified into six informal groups based on

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