

***Clerodendrum* confusion—redefinition of, and new perspectives for, a large Labiate genus**

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ABSTRACT. Formerly referred to Verbenaceae s.l., *Clerodendrum* L. is one of the largest genera within the Lamiaceae (Labiatae) s.l., and many of its species are of ecological and commercial importance. However, confusion about species delimitation and identification has reigned for many decades, resulting in large quantities of unidentified, or misidentified, herbarium material. Results from recent molecular studies have provided a framework for accurate placement of taxa. The revised concept of the genus is applied to taxa in Malesia in order to produce a modern account for Flora Malesiana, which includes up-to-date descriptions and much-needed keys. Progress made so far is reported.

Keywords. *Clerodendrum*, Labiatae, Lamiaceae, Malesia, Verbenaceae s.l.

Introduction

The long-standing Flora Malesiana project, first and foremost, aims to create “a systematic account of the flora of Malesia, the plant-geographical unit spanning six countries in Southeast Asia” (www.floramalesiana.org). With such high botanical diversity in the region (an estimated 42,000 plant species: Roos 1993) and general paucity of funds for research, why is *Clerodendrum* a genus worthy of particular note?

Clerodendrum is a large genus containing species that are important both ecologically and commercially. The ecology of, often genus-specific, associations with microfungi (Hosagoudar & Archana 2009, and see Minter 2010), and relationships with ants (Maschwitz et al. 1994) and pollinators (Corner 1940, Yuan et al. 2010) has been studied to a limited extent though further research is required in order to understand these complex interactions. Some species are early successional colonisers of degraded land (e.g., *C. japonicum* (Thunb.) Sweet) and could be used for habitat restoration, but, others, like *C. chinense* (Osbeck) Mabb., can become pernicious weeds, so that accurate identification and careful consideration must go hand-in-hand before implementing restoration work. Many of the Malesian and other species are highly ornamental, having large showy inflorescences and attractive foliage, and some are already popular in the global horticultural trade (several, including the spectacular orange red and cream to pale yellow-flowered forms of *C. paniculatum* L., can be



Fig. 1. Two colour forms of *Clerodendrum paniculatum* are popular in cultivation due to their striking inflorescences and foliage (one form has cream to pale yellow corollas with green inflorescence branches, and the other has pale orangey-red corollas with red inflorescence branches). These plants are growing in the Singapore Botanic Gardens. Photos by J.A. Wearn, 2010.

seen in the Singapore Botanic Gardens, for example; see Fig. 1). *Clerodendrum* species have also been used medicinally for centuries in their countries of origin and rigorous scientific trials are now underway to evaluate the potential of compounds extracted from them, notably those with antipyretic and anti-inflammatory properties (examples are cited in Shrivastava & Patel 2007), and antiviral activity (Kim et al. 2001).

Clerodendrum was long referred to Verbenaceae s.l. but its placement was corrected following a series of molecular-based studies (Olmstead et al. 1993, Wagstaff et al. 1998), such that it now falls into Lamiaceae (Labiatae). Molecular studies during the 1990s lacked resolution below family level as only a few species from each of the constituent genera were included. Although previously considered as a pantropical and eastern temperate genus, it was recognised that *Clerodendrum* in this broad sense was heterogenous and likely to be polyphyletic. The need for elucidation of inter- and intrageneric relationships was addressed in a landmark paper by Yuan et al. (2010), using cpDNA from 56 taxa (including 40 *Clerodendrum* species, *sensu* Steane et al. 2004). They showed that the native American species were misplaced in *Clerodendrum* and so those are now referred to other genera. Many of the African taxa had already been excluded and placed in a revived *Rothea* Raf., a more distantly allied genus (Steane & Mabberley 1998, Steane et al. 2004). A combination of molecular and morphological taxonomic studies necessitated reassessment of traditionally used morphological characters, allowing the focus to be directed towards those characters now seen as most relevant for taxonomic delimitation at the generic level and below. Thus, a redefinition of *Clerodendrum* s.s. and its allies was completed (Yuan et al. 2010). This allowed us to undertake a reassessment of all Malesian taxa, previously considered to be '*Clerodendrum*'.

Towards a reassessment of Malesian taxa

When Moldenke (1985: 310) wrote of *Clerodendrum sensu lato*, he referred to 584 taxa, the majority of which had one or more synonyms. Now numbering approximately 150–180 species, *Clerodendrum* is an exclusively Old World genus, its species distributed largely within the tropics and subtropics with some found as far south as Australia and as far north as central China and Japan. Outside Africa, the majority of *Clerodendrum* species is found in the Malesian region but there has been no major revisionary work on those for nearly a century. Thus, at the outset, we were largely reliant upon the accounts of Schauer (1847) and Lam (1919). An account by Backer & Bakhuizen van den Brink (1965) included taxa found in Java while a series of later papers (Moldenke 1985–87) covered the genus only in part, with some questionable infraspecific delimitation and other circumscriptions. One of us (DM) had prepared a manuscript account of the genus and its allies for the Flora of Peninsular Malaysia (Mabberley, in press) but it became obvious very quickly, from the literature alone, that there were a multitude of names in use and abundant synonymy (varying depending on the author) applied to taxa beyond the Malay Peninsula. However, it was not until one of us (JW) began to trawl through the large numbers unidentified or misnamed

collections in herbaria that the confusion of species concepts and the full extent of the task were realised. It was not uncommon for material to have been reidentified several times—in some cases reaching a nomenclatural ‘full circle’, where the last botanist viewing a particular collection had disagreed with those before him/her but agreed with the original, contemporary identification! It soon became apparent that the Flora Malesiana account would require a revision of monographic intensity.

Flora Malesiana and the future of *Clerodendrum*

As we near the end of our reassessment of *Clerodendrum* in Malesia, 210 names have been considered since our project began in mid-2008 (Wearn & Mabberley, in prep.). So far, 53 species are recognised, 13 names have been excluded from the genus (referred to *Faradaya* F. Muell., *Hosea* Ridl., *Rothea* and *Volkameria* L.) and two have been excluded from the *Flora Malesiana* account due to incorrect understanding of distributions (species now thought to be native or naturalised only outside Malesia). A further eight names remain ‘insufficiently known’. The loss of type material and lack of other collections aligning with the descriptions has meant that no progress in such cases can yet be made. For example, *Clerodendrum barba-felis* Hallier f. was described based on material deposited at WRSL, with a duplicate at PNH, now both lost, with no conspecific material found elsewhere. This situation is by no means peculiar to *Clerodendrum* as nearly every volume of Flora Malesiana contains names excluded from accounts in this way. Unfortunately, it is a geographically and taxonomically wide-ranging phenomenon, owed in part to the destruction of herbaria or loss of sets through auctions, fires and so on, but perhaps also through the rarity of the species described. Considering the rate of destruction of habitats in Malesia, the species that have not been collected for over 50 years may now be extinct, particularly as *Clerodendrum* species are by no means cryptic.

While many *Clerodendrum* species are not considered of conservation concern, being commonly collected (e.g., *C. disparifolium* Blume), several have not been seen in Malesia for 50 years or more (e.g., *C. umbratile* King & Gamble (Mabberley, in press)), whether due to geographical sampling effort or species rarity. A few species have very restricted geographical ranges and are considered vulnerable (e.g., *C. lankawiense* King & Gamble, which is found only on certain islands off south-west Peninsular Thailand and northwest Peninsular Malaysia (Mabberley, in press)). Others, such as *C. albiflos* H.J. Lam from New Guinea and *C. multibracteatum* Merr. from the Philippines, are known from only one or a few collections, and so have to be categorised as ‘data deficient’ until more is known. Unfortunately, but perhaps not surprisingly, the species that are in cultivation are those which are common naturally, perhaps due as much to the ease with which they can be propagated and grown as it is a result of their floral appeal. Currently, there is no *ex situ* conservation resource.

Plants of the genus are commonly encountered during fieldwork but frequently unidentified, or worse, misidentified so that they end up in completely the wrong herbarium cupboard. We hope that our work for Flora Malesiana will clarify

the seemingly ubiquitous confusion which has dominated this large and important genus for so long because our revision of Malesian *Clerodendrum* taxa has allowed preparation of new descriptions and keys (Wearn & Mabberley, in press, in prep.), which are a prerequisite for accurate identification in the field and herbarium. These will aid taxonomists as well as those undertaking conservation and restoration work.

In conclusion, the importance of interdisciplinary collaboration (such as between taxonomists, ethnobotanists and ecologists) and knowledge exchange must be emphasised, as through this process much more can be understood about the taxa we study. Indeed, the information that one seeks may have been already documented, but until experts in other disciplines are consulted, no-one may be able to make full use of the incomplete knowledge. For example, during this work, JW found that *C. rumphianum* de Vriese & Teijsm., described from Ambon in Indonesia, was poorly known by taxonomic botanists. An adequate account of the plant was created only as a result of contact with an ethnobotanist (Roy Ellen at the University of Kent). RE had encountered the plant several times during long-term (1970–present) research on the neighbouring island of Seram and was able to provide much additional information including photographs and notes on local uses, in addition to much-needed recent material (Wearn & Ellen, in prep.).

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