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Development of a multi-access key to the ferns of Thailand

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ABSTRACT. This paper explains why the fern account in the *Flora of Thailand* needs to be updated and provides details of a project to develop a web-accessible multi-access key that incorporates these updates.

INTRODUCTION

Ferns are a large and conspicuous component of the plant diversity of Thailand with an estimated 670 taxa. This is about 5–7% of the total vascular flora of Thailand (Middleton, 2003), and a significant proportion of the world's fern flora (estimated to be between 9,000 and 12,000 species (Smith *et al*., 2006; Moran, 2008).

The ferns were compiled for the *Flora of Thailand* in four parts (Tagawa & Iwatsuki, 1979, 1985, 1988, 1989). 596 taxa were recognised as occurring in Thailand (excluding the lycophytes - Lycopodiaceae, Selaginellaceae and Isoetaceae). Although the Flora account was a great contribution at the time of publication it now needs to be updated for three reasons: 1) Some new taxa have been described and many new records published; 2) Continuing taxonomic work has radically altered familial and generic concepts in many groups; and 3) The complex and specialised terminology for ferns, and the lack of a comprehensive glossary in the *Flora of Thailand*, is a barrier for non-specialists attempting to identify Thai ferns.

Since the *Flora of Thailand* accounts were published many new records and new taxa have been reported for Thailand (Mitsuta, 1985; Parris, 1998; Hovenkamp *et al*., 1998; Nooteboom, 1998; Boonkerd & Nooteboom, 2001; Boonkerd & Pollawatn, 2000, 2002a, 2002b, 2006; Lindsay & Middleton, 2004; Lindsay *et al*., 2004, 2008; Suksathan, 2004; Boonkerd *et al*., 2004; Boonkerd, 2006; Parris, pers. comm.). Approximately 70 taxa have now been recorded in the country that are not accounted for in the Flora account. Consequently very many of the keys to genera and species do not work and new resources are necessary to identify the ferns of Thailand.

In addition to the new taxa there have been significant changes in fern taxonomy, largely due to insights from molecular phylogenetic work. Much of this has been synthesised by Smith *et al*. (2006, 2008) who provide a comprehensive family structure and a list of the currently recognised genera. Any modern taxonomic work on Thai ferns needs to reflect the changed taxonomic concepts. The following families which were recognised

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in the *Flora of Thailand* have now been synonymised: Athyriaceae, Grammitidaceae and Parkeriaceae. Others have very different circumscriptions: e.g., Dryopteridaceae, Polypodiaceae and Pteridaceae. Generic concepts have been altered in almost all fern families but are particularly far-reaching in Thelypteridaceae, Hymenophyllaceae and Polypodiaceae. The consequences of this for Thailand are that approximately 30% of the ferns listed in the *Flora of Thailand* have moved to new families; approximately 20% of the species are now in different genera; some very familiar genera (e.g. *Grammitis*, *Polypodium*, *Trichomanes* and *Vittaria*) are no longer recognised in Thailand; and some new combinations are required.

Much of this new information will be published in traditional print format, such as the *Thai Forest Bulletin*, and indeed we will publish a follow-up paper with a comprehensive listing of all Thai ferns and the changed taxonomic landscape in the near future (Lindsay *et al*., 2009). However, Boonkerd *et al*. (2004) have highlighted the need to synthesise information on Thai ferns and provide the information in a way that is accessible to general users through the development of a computer-based, multi-access key.

Making accurate and usable identification keys is a fundamental aim of floristic research. Traditionally these have been presented in the form of dichotomous printed keys that have often been written by specialists for similar specialists and contain very little explanatory information. More recently a number of computer programmes have become available that make it much easier for specialists to create user-friendly multi-access keys and other electronic identification tools that are of use and interest to a broader range of people and professions. The principles of these have been set out by Dallwitz *et al*. (2005) and the possibilities for the future, including electronic field guides, have been discussed by Agarwal *et al*. (2006).

MULTI-ACCESS KEY

A multi-access key to the ferns of Thailand is now being developed. The project is being coordinated from the Royal Botanic Garden Edinburgh and is in collaboration with the Forest Herbarium Bangkok, Chulalongkorn University and Queen Sirikit Botanic Garden. The key is being developed using the Lucid software and will be presented through a dedicated Thai fern website served from the Royal Botanic Garden Edinburgh (http://rbg-web2.rbge.org.uk/thaiferns). We should like to include photographs of all the ferns occurring in Thailand and, to this end, we would appreciate hearing from any botanists who might have photographs that we can include on the site (all contributions will be fully acknowledged). The website will also include a comprehensive illustrated glossary of pteridological terms and, in time, all information on the website will be presented in English and Thai. Once completed the Thai fern website and multi-access key will be a vital resource for the identification and conservation of ferns in Thailand. In addition, the standardised character set that has been developed through the *IdentifyLife* project (http://www.identifylife.org), and which we have adopted, will enable future researchers to expand our key into neighbouring countries.

CONCLUSIONS

Systematists argue that wider society depends upon having access to biodiversity information in order to understand the natural world (Farr, 2006). However, obtaining this information has traditionally been limited to those with access to natural history collections and well-stocked libraries. To quote from Farr (2006), "The Internet has changed this equation". With ever expanding access to the Internet, and the potential for future hand-held systems linked to the Internet, access to biodiversity information may only be limited by what is available there. Through the development of a multi-access key to Thai ferns we will synthesise and build upon all of the taxonomic research that has been done in recent years; the data presented will provide the grounding for conservation assessments of Thai ferns using the criteria laid down by the IUCN (2001); it will be freely available for students and the general public wishing to learn more about Thailand's ferns; and it will greatly enhance access to information on Thai ferns by being electronically available.

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