CHAPTER IV
GENERAL CONCLUSION AND DISCUSSIONS

Systematic study of tribe Vernonieae in Thailand was conducted based on morphology and on molecular techniques. The first publications, specimen examinations, descriptions with distinguishing characters are illustrated and habitat and distribution maps provided. The results show that there are 51 taxa in five subtribes, 16 genera and 48 species. Fourteen species are endemic to Thailand; seven in *Acilepis*, *A. chiangdaoensis*, *A. doichangensis*, *A. namnaoensis*, *A. ngaoensis*, *A. principis*, *A. sutepensis* and *A. pseudosutepensis*, four in *Camchaya*, *C. pentagona*, *C. spinulifera*, *C. tenuiflora* and *C.* sp. and three not yet placed in any subtribe, *Koyamasia calcarea*, *Vernonia curtisii* var. *tomentosa* and *V. pseudobirmanica*. Moreover, two new genera are published here. The first genus is the monotypic *Iodocephalopsis* formerly in the genus *Iodocephalus*. The second one, *Kurziella*, is also monotypic and was formerly *Vernonia gymnoclada*. Both of them are primarily found in Myanmar and Indo-China. In addition, one new combination is proposed; *Iodocephalus gracilis* Gagnep is now *Camchaya gracilis*. *Camchaya* is the only genus with 6-porate pollen, a feature found in the former *Iodocephalus gracilis* and therefore wrongly placed in that genus. Two species are also newly recorded for Thailand. They are *C. gracilis* previously reported only in the neighbouring countries, Laos and Cambodia, and *Pseudelephantopus spicatus* which is never previously been collected in Thailand or any of its neighbouring countries. Finally, one species of genus *Camchaya* (*C.* sp.) is likely new to science and further studies are underway to verify this.

Members of the Vernonieae grow in many different forest types from low (0 m) up to high (2,000 m) elevations. Most species are found in northern and northeastern floristic regions, while only a few species occur elsewhere (*i.e.* east and southwest). Most species are found at high elevation in open areas within dipterocarp, pine-oak and hill evergreen forests. Some species are restricted to limestone such as *Koyamasia calcarea*, *Vernonia birmanica* and *V. curtisii*, while others grow in lowland saline

soil, *i.e. Kurziella gymnoclada* and *Tarlmounia elliptica*. Eight species are described on the basis of only a small number of field collections. This is due to their rarity, restricted habitats, and poor distributional information. These are *Acilepis doichangensis, A. tonkinensis, A. virgata, Camchaya kampotensis, Etulia conyzoides, Vernonia birmanica, V. pseudobirmanica* and *V. pulicarioides*.

Phenetic groupings based on 46 morphological characters for the 42 species in this study were established based on habit, leaf, flower, achene and pollen. The results, shown in the UPGMA phenogram (Fig. 3.1) are five groups which correlate with the Vernonieae subtribal classification of Keeley and Robinson (2009) and are also similar to those clades identified in the phylogenetic trees of the combined molecular and morphological data sets (Fig 3.3, 3.4). These phenetic groups are approximately equivalent to the following clades:

Group I	= Elephantopinae
Group II	= Centrapalinae
Group II	= Gymnantheminae I & II
Group IV and V	= Erlangeinae I & II and Centrapalinae

The phylogenetic analyses of combined ITS, ndhF, trnL sequences and the morphological data set gave the best resolved trees whereas no single partition alone was sufficient to provide a fully resolved phylogeny. BA shows better resolution and higher support values than MP analyses. The phylogenetic trees reveal that the Thai Vernonieae are monophyletic. However, not all of the subtribes are similarly monophyletic, at least as currently placed to subtribe. For example, Gymnantheminae is polyphyletic and the Erlangeinae is paraphyletic. Others, such as the Centrapalinae and Elephantopinae are monophyletic, but may not be if analyzed with African members (Robinson, pers. comm.), something that remains to be investigated. *Koyamasia gymnoclada* is basal to the rest of the Thai Vernonieae in the BA as are woody species in general. Despite the presence of the two species *Iodocephalopsis eberhardtii* and *Camchaya gracilis* which are newly recognized, the subtribe Centrapalinae remains clearly monophyletic. Similarly, *Elephantopus* and *Pseudelephantopus* in subtribe Elephantopinae are monophyletic and do not change any previous results (summarized in Keeley & Robinson, 2009). On the other hand,

Monosis volkameriifolia is not part of any other clade or subtribe despite having a prior assignment in the Gymnantheminae and must be transferred to a different subtribe.

Name changes will be required for *Gymnanthemum cylindriceps* which is clearly a member of *Decaneuropsis* and for *Vernonia cinerea* var. *montana*. The latter taxon is putatively a variety of *V. cinerea*, placed in the genus *Cyanthillium* (as *C. cinereum*) by Robinson (1999b). However, this variety is more closely related to *C. hookerianum* than *V. cinerea* var. *montana* indicating that the current nomenclature does not reflect the correct relationship and requires revising the generic nomenclature and correcting its subtribal placement. Similarly, *Vernonia curtisii* is not only closely related to *Koyamasia calcarea* but also shares with it restriction to the same limestone habitat and morphological characters of a short bristly and caducous pappus, reflexed phyllaries and echinolophate 3-porate pollen type. To ensure monophyly both taxa will need to be placed in the same genus. Finally, the subtribal placement of three species, *Vernonia birmanica, V. pseudobirmanica* and *V. pulicarioides*, remains to be determined. They each have characters in common with some of the other Thai taxa, but will require further study to determine the best placement within the tribe.

Thai Vernonieae have geographically limited distributions and high endemicity. These features strongly suggest a distinct evolutionary line for the Thai Vernonieae within the Old World members of the tribe. Further studies will likely result in the recognition of subtribes or sections for these taxa.