Systematic treatment of the Sematophyllaceae (Musci) in Thailand

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A taxonomic study of the Sematophyllaceae in Thailand was carried out based on more than 2000 specimens. These specimens were on loan from the main herbaria in Thailand, Europe and America together with additional collections by the authors. Gross morphological studies were conducted of all organs of each specimen under the microscope. An artificial key, description, distribution, ecology, illustrations and photos of each species are provided. Enumeration of this moss family revealed 24 genera, 97 species, 5 varieties and 1 form. Three genera, *Pseudotrismegistia, Heterophyllium,* and *Pylaisiadelpha*, are new additions to the Flora of Thailand. Eleven species and 2 varieties are endemic to Thailand, i.e. *Acroporium convolutifolium* Dixon, *A. hamulatum* (M. Fleisch.) M. Fleisch. var. *procumbens* (M. Fleisch.) Dixon, *A. secundum* (Reinw. & Hornsch.) M. Fleisch. var. *siamense* Dixon, *Mastopoma subfiliferum* Horikawa & Ando, *Rhaphidostichum leptocarpoides* (Broth.) Broth., *Sematophyllum subrevolutum* Broth., *Taxithelium clastobryoides* Dixon, *T. epapillosum* Dixon, *T. inerme* P. Tixier, *Trichosteleum trachycystis* Broth. and *Wijkia filipendula* (Dixon) H. A. Crum. Eleven species reported as new to Thailand are *Acroporium johannis-winkleri* Broth., *A. rufum* (Reinw. & Hornsch.) M. Fleisch., *A. sigmatodontium* (Müll & Hal.) M. Fleisch., *Aptychella speciosa* (Mitt.) P. Tixier, *Brotherella erythrocaulis* (Mitt.) M. Fleisch., *Chionostomum baolocense* Tixier, *C. inicola* Tixier, *Hageniella assamica* Dixon, *Rhaphidostichum piliferum* (Broth.) Broth., *Taxithelium parvulum* (Broth. & Paris) Broth. and *Wijkia hornschuchii* (M. Fleisch.) H. A. Crum. The phytogeography of this family confirm the previous hypothesis that Thailand is a traditional region forming a bridge between the Malayan-Philippine and Sino-Himalayan floras.

Taxonomic revision of the fern *Microsorum punctatum* (L.) Copel. complex (Polypodiaceae)

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Microsorum punctatum (L.) Copel., a widespread species with great variation in many characters, has been proposed as a species complex and so is worth investigating. In order to investigate this doubtful taxon, more than 1,500 specimens deposited at BCU, BKF, BM, K, B, L and P were studied. Based on morphological and anatomical characters, the *M. punctatum* complex can be divided into 8 taxa. This corresponded well with the results of cluster analysis and canonical discriminant analysis performed on 707 herbarium specimens. Twenty three quantitative and 35 qualitative characters were employed. Cluster analysis revealed the separation of the taxa in the species complex into eight groups. The eight-cluster grouping is discussed. From a canonical discriminant analysis using the eight-cluster grouping as a priori groups, it was concluded that *M. siamense*, *M. thailandicum*, *M. membranaceum*, *M. glossophyllum* and *M. musifolium* are obviously distinct taxa, while specimens of *M. steerei* and *M. whiteheadii* mixed together and should be proposed as the same species. Likewise, the specimens of species previously recognized as the other 10 synonyms of *M. punctatum* are not distinct from *M. punctatum* and are treated here as members of *M. punctatum.* The six most important characters that separated the eight species are stipe length, number of sori row between the adjacent secondary vein, sori diameter, sori density, primary-areole width, and spore width. These quantitative characters, together with some qualitative characters, were useful in constructing an identification key to these species. According to RAPD data, two cultivar varieties can still be recognized. The results of phylogenic study agreed with morphological and morphometric studies that separated *M. glossophyllum* and *M. musifolium* from *M. punctatum*. *M. membranaceum* and *M. musifolium* formed the most basally positioned monophyletic clade of the complex. The larger clade was divided into four recognizable subclades.

A taxonomic revision of *Fissidens* Hedw. (Bryophyta: Fissidentaceae) in Thailand

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Thirty-eight species and 4 varieties of *Fissidens* Hedw. are known in Thailand. These include 2 new species (*F. kanyanii* K. Wong. & B.C. Tan and *F. bentanii* K. Wong. & Santa.) and 6 new records (*F. crispulus* Brid. var. *robinsonii* (Broth.) Z. Iwats. & Z.-H. Li, *F. flaccidus* C. Muell., *F. incognitus* Gangulee, *F. involutus* Wils. *ex* Mitt., *F. jungermanniodes* Griff., and *F. serratus* C. Muell.). Eight hundred and sixty four specimens were collected from 10 National Parks (Doi Inthanon, Doi Suthep-Pui, Pha Daeng, Phu Hin Rong Kla, Phu Phan, Pu-Toei, Khao Yai, Nam Tok Ngao, Khao Nan, amd Phanom Pencha) and Chiang Dao Wildlife Sanctuary. This study revealed new species and new records and new taxonomic and ecological information on Thai *Fissidens* will be added. More collecting in other areas in Thailand is needed to determine if more species are in the country.

Taxonomy of the Lejeuneaceae subfamily Ptychanthoideae (Bryophyta, Hepaticae) from nine National Parks in Thailand

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One hundred and forty specimens of leafy liverworts of the family Lejeuneaceae, subfamily Ptychanthoideae, were collected from nine National Parks in Thailand (Doi Suthep-Pui, Doi Inthanon, Pha Daeng, Phu Phan, Pha Taem, Mu Koh Chang, Nam Tok Ngao, Khao Phanom Bencha, and Khao Nan). Nine genera and eighteen species were found. Fifteen species were epiphytes, two species were either epiphytes or epiliths, and one was an epiphyllous species. *Mastigolejeunea* (5 spp.) and *Lopholejeunea* (4 spp.) were the most common genera. *Acrolejeunea fertilis* (Reinw. *et al.*) Schiffn. grows under a wide range of habitats, *i.e.* dry to moist habitats. It is also the most common and abundant species of Ptychanthoideae found in deciduous dipterocarp forest (500-1000 m).

The effects of shoot density on growth, recruitment and reproduction of *Enhalus acoroides* (L.f.) Royle at Had Chao Mai National Park, Trang Province, Thailand

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Enhalus acoroides (L.f.) Royle is one of the largest species of seagrass and is common in the Indo-Pacific tropics. In Had Chao Mai National Park, Trang, *E. acoroides* grows in dense meadows, in which plants might undergo intraspecific competition and self-shading. The aim of this study is to investigate the effects of density on growth, recruitment and reproduction. Experiments were carried out from August 2006 to July 2007 in a monospecific meadow of *E. acoroides* by placing ten permanent quadrats (0.25 m^2) in each of 4 densities designated as follows: 100% density (35 shoots/ quadrat), 50% density (18 shoots/ quadrat), 25% density (9 shoots/ quadrat) and 10% density (4 shoots/ quadrat). The densities were manipulated by cutting the shoots at the leaf bundle meristem. Leaf elongation rate, leaf surface area, shoot weight, number of new shoots and numbers of flowers and fruits were estimated by statistical sampling methods. In addition, the light intensity under canopies was measured. The analysis of results showed that there was no intraspecific competition between plants in the dense meadow as indicated by the slope of log mean ramet weight versus log density which does not follow the -3/2 power self-thinning rule of Yoda *et al*. (1963). However, leaf surface area, recruitment rate and total flower and fruit production at low densities were higher than at high densities. The results suggest that self-shading occurred and that light availability is an important factor in the regulation of growth, recruitment and reproduction.

Effect of seasonal variation on growth and sexual reproduction of *Thalassia hemprichii* (Ehrenb.) Aschers in Haad Chao Mai National Park, Trang Province, Thailand

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Thalassia hemprichii (Ehrenb.) Aschers is one of the dominant seagrass species found in mixed seagrass beds throughout SE Asia. This species is also dominant in Haad Chao Mai National Park, where it forms the largest seagrass bed in Thailand. In this study, not only the physical parameters (such as light intensity, temperature) and chemical parameters (such as nutrients in water and nutrients in sediment) will be measured, but also the biomass, and growth rates of leaves, flowers and fruit of *T. hemprichii* will be investigated. The effects of physical and chemical parameters on growth and sexual reproduction of *T. hemprichii* will be investigated. Seasonal variation of growth and sexual reproduction of *T. hemprichii* will be studied throughout the year. Field collection will be carried out monthly, and has already started since January 2008. It will be completed in January 2009. The study will reveal the seasonal variations in *T. hemprichii* growth and reproduction in Haad Chao Mai National Park.

Fishery resource value of seagrass beds utilized by the community of Libong Island, Trang Province

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Libong Island located in Trang Province has the biggest seagrass bed in Thailand; this bed is rich in species diversity. Due to the characteristics of seagrass beds as open access resources, non-exclusive use is allowed and this causes seagrass deterioration. To prevent this problem, government and non-government organizations have provided information about the functions and benefits of seagrass to local people in order to change people's attitudes and behaviors regarding the use of seagrass resources. However, it takes time for the people of a community to change their behavior. This study will use the Market Value Approach to estimate the fishery resource value of seagrass beds utilized by a community, and will focus on economic aquatic animals of Libong Island's seagrass bed. This value quantifies the monetary benefits of the seagrass bed that are obtained and broadly shared among local people and gives the reasons for the importance of awareness and conservation of seagrass biodiversity. This research continues to study seagrass bed utilization by people in Libong Island and the factors affecting the fishery resource value of the seagrass bed at Libong Island. Local government and NGOs should benefit from using this information for preparing guidelines to manage the seagrass bed efficiently and assure environmental sustainability.

Classification of bamboos (Poaceae; Bambusoideae) in Thailand inferred from a multi-gene region phylogenetic analysis

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Over 60 taxa representing all the bamboo subtribes *sensu* Clayton and Renvoize (1986) and Orhnberger (1999) and related non bambusoid grasses were sampled. A combined analysis of five plastid DNA regions, *trnL* intron, *trnL-F* intergenic spacer, *atpB-rbcL* intergeneric spacer, *rps16* intron, and *matK*, was used to study the phylogenetic relationships among the bamboos in general and the woody bamboos in particular. The BEP (Bambusoideae, Ehrhartoideae, Pooideae) clade was resolved and Pooideae was supported as a sister group to Bambusoideae s.s.. Traditional Bambuseae, the woody bamboos, were not monophyletic. Olyreae, the herbaceous bamboos, was a sister group to tropical Bambuseae. Temperate Bambuseae was a sister group to the group consisting of tropical Bambuseae and Olyreae. Melocanninae was a sister group to the remaining tropical Bambuseae. The traditional Bambuseae were re-defined and the use of the tribal name Arundinarieae was recommended to accommodate the temperate woody bamboos. Classification of the bamboos will be discussed in relation to the commonly used classification systems, and patterns of diversification will be interpreted within a biogeograpic context.

Rice genomics for understanding the evolutionary story of rice: From Asian wild rice (*Oryza rufipogon* Griff.) to Asian cultivated rice (*O. sativa* L.)

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One of the most fundamental questions regarding the evolution of Asian cultivated rice, *Oryza sativa* L. (spp. *indica* or *japonica*), is the geographic origin and the number of times domestication has occurred for this rice species. The wild progenitor, *O. rufipogon* Griff.,, has been identified using a combination of morphological, biochemical, and genetic studies. Coupled with the geographic ranges of the ancestral species and phylogenetic data, the origin of Asian cultivated rice is now being uncovered. These data suggest that Asian cultivated rice was domesticated at least twice from different *O. rufipogon* populations and that the products of these two independent domestication events are the two major rice subspecies (i.e., *indica* and *japonica*). Sequencing of the whole genome of rice has predictably resulted in a rapid surge in research on rice genetics and evolution. Cloning rice genes has concentrated on the most important domestication-related genes. There are four major genes that have been reported, i.e., the *Waxy* gene, *Rc* gene, shattering gene, and fragrance gene. This presentation is aimed to help us understand the history and origins of genetic mutations that have changed wild rice into cultivated rice.

The fragrance (*fgr*) gene in natural populations of wild rice (*Oryza rufipogon* Griff.)

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The Asian cultivated rice, *Oryza sativa* L. (spp. *indica* or *japonica*), is assumed to have originated from one or both of the two wild Asian species, *O. rufipogon* Griff. and *O. nivara* Sharma and Shastry. They occur throughout monsoonal Asia and west Oceania. Fragrance is the most important trait among the domesticated characters of basmati and jasmine rice of Asia. The gene for fragrance in scented rice, *fgr*, shows the presence of a mutated portion (i.e., an eight base pair deletion in exon 7) that results in the loss of its function. In the present study, 229 wild rice *O. rufipogon* accessions were genotyped for this locus using a PCR assay. The wild rice species contained the mutated allele of the *fgr* gene at a low frequency of 0.23. The surveyed populations were in Hardy–Weinberg equilibrium. This observation supports the hypothesis that the allele for fragrance was already present in the wild rice, and that this trait appeared in scented rice cultivars because of selection by farmers of genotypes possessing this character during the process of domestication.

Rice landrace diversity and community conservation in Northeastern Thailand

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Rice is one of the most important food grains in the world. Almost 3,000 million people particularly Asian people consume rice as the main staple food. Today, the diversity of rice varieties has declined and disappeared significantly because of the main system of monocultural and commercial agricultural production, which is supported mainly by government policy. This research aims to study local knowledge and local farmers in Northeastern Thailand in order to understand how they conserve their traditional rice varieties. This study uses agro-morphological traits, genetic diversity, and the geographical information system (GIS) to analyze substantial data collected from rice fields. This is to examine how the diversity of rice varieties could be possibly promoted in localities, in a type of *in-situ* conservation.

Molecular systematics of *Kaempferia* (Zingiberaceae) in Thailand

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Plants in the genus *Kaempferia* (Zingiberaceae), especially *K. parviflora* (Krachai Dum), are well-known as medicinal herbs. Some species are also useful as vegetables, ornamentals or incense. About 20 species are enumerated for Thailand. However, the morphological similarity among plants in the Zingiberaceae and morphological variations within species makes it difficult to distinguish plants. To date, 40 accessions of *Kaempferia*, representing 14 recognized, 5 new and 1 unidentified *Kaempferia* species in Thailand, have been examined by sequencing of *psbA-trnH* and *petA-psbJ* spacer regions. Six species of closely related taxa (*Gagnepainia godefroyi*, *Gagnepainia thoreliana*, *Smithatris supraneanae*, *Scaphochlamys biloba*, *Scaphochlamys minutiflora*, and *Stahlianthus* sp.) were also included. After multiple sequence alignments, sequences of 957 and 835 bp in length were obtained from *psbA-trnH* and partial *petA-psbJ*, respectively. Pairwise divergence of *psbA-trnH* ranged from 0.00-3.04% (*K. filifolia* and *K. rotunda*) while pairwise divergence of *petA-psbJ* ranged from 0.00-3.40% (*Kaempferia*.sp.2 and *S. biloba*). Based on both data sets, intraspecific sequence variation was not observed in 4 species, namely *K. candida*, *Kaempferia* sp.1 (Phor Suatam), *Kaempferia* sp.3 (Phor Saraburi), and *G. thoreliana* for which more than 1 specimen was available. In contrast, intraspecific sequence variations were observed among different populations of *K. elegans*, *K. pulchra*, *K. rotunda*, *K. marginata*, *K. larsenii*, *K. siamensis*, and *K. parviflora*.

Taxonomic revision of the family Stemonaceae in Thailand

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A taxonomic revision of the family Stemonaceae in Thailand was conducted by searching the literature, comparing herbarium specimens from several herbaria in Thailand and data gained from the Kew Herbarium. Additional field surveys and specimen collections were made thoughout the country. There are 10 species, which belong to 2 genera, *Stemona* Lour. comprised of 9 species,namely *Stemona aphylla* Craib, *S. burkillii* Prain, *S. cochinchinensis* Gagnep., *S. collinsiae* Craib, *S. curtisii* Hook.f., *S. kerrii* Craib, *S. phyllantha* Gagnep., *S. pierrei* Gagnep.and *S. tuberosa* Lour., and the genus *Stichoneuron* consisting of one species, *Stichoneuron caudatum* Ridl. Two species are endemic to Thailand, *i.e., Stemona aphylla* Craib and *S. collinsiae* Craib. *Stichoneuron caudatum* Ridl. is endemic to the Malay Peninsular. Two species, *i.e., Stemona cochinchinensis* Gagnep. and *S. pierrei* Gagnep., are new records for Thailand.

Taxonomy of *Goniothalamus* (Blume) Hook. f. & Thoms. (Annonaceae) in Thailand

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Twenty specimens of *Goniothalamus* in Thailand were collected, of which 16 species were identified and 4 were unidentified. Among these are 5 new records for Thailand, namely *G. elegans, G. cheliensis, G. repevensis, G. sawtehii* and *G. umbrosus.*

Many characters were taxonomically important, with variation evident in size, shape, colour and indumenta. The characters that were used taxonomically for Thai *Goniothalamus* taxa are the presence or absence of hairs on the surfaces of leaves, sepals, outer petals and inner petals. The whole dome shape needs to be considered as a unit for taxonomic analysis. Its morphology is diverse within the genus, with at least six distinct types. Another notable structure is the pistil, including stigma shape and indumentum. There were six types of stigmas. Moreover, ovule number is taxonomically important as well. The staminal connectives are very variable in shape, with truncate, convex, short apiculate, long apiculate and sharply apiculate forms. Elements of both Boerlage's and Bân's infrageneric classifications are reflected in Thai *Goniothalamus,* although many species could not be classified into the sectional level of Bân's classification. Thai *Goniothalamus* cannot be classified into sectional levels using Bân's classification because they have more diverse characters than those that Bân proposed.

However, if more samples from a wider distribution of the genus and tribe are available, it would be useful for further study. This preliminary study can be used for further research of *Goniothalamus*.

Distribution of *Uraria* Desv. (Leguminosae) in Thailand

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The genus *Uraria* Desv. (Leguminosae) in Thailand was preliminarily studied. Thirteen species are enumerated. *Uraria crinita* (L.) Desv. ex DC., *U. lagopodioides* (L.) Desv. ex DC., *U. picta* Desv., and *U. rufescens* (DC.) Schindl. are widespread; especially the first two species are the most common species. *U. acaulis* Schindl., *U. acuminata* Kurz, *U. campanulata* (Benth.) Gagnep., *U. cordifolia* Wall., *U. pierrei* Schindl. and *U. rotundata* Craib are found in many areas except in Southern Thailand. *U. lacei* Craib and *U. poilanei* Dy Phon are restricted to Northern Thailand and *U. cochinchinensis* Schindl. Is found only in Sakon Nakhon, Surin and Si Sa Ket provinces.

Taxonomy of Amaryllidaceae, Asparagaceae, Boraginaceae, Piperaceae, Polygonaceae and Eragrostideae (Poaceae) in Thailand and *Indigofera* L. (Leguminosae) and Myrtaceae in Laos PDR

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A taxonomic account of some plant groups in Thailand and Laos PDR is presented. Field collections have been conducted and herbarium specimens have been examined throughout the two countries. There were determined two genera and six species in Amaryllidaceae, one genus and six species in Asparagaceae, 10 genera and 35 species in Boraginaceae, three genera and 48 species in Piperaceae, seven genera and 33 species in Polygonaceae and 10 genera and 60 species in Eragrostideae (Poaceae) in Thailand. *Crinum thaianum* J. Schulze, *Ehretia winitii* Craib, *Tournefortia intonsa* Kerr and *Trichodesma calcareum* Craib are endemic to Thailand. Eight species of Piperaceae and one in Polygonaceae are expected to be new to science. Eighteen species of *Indigofera* and 10 genera and 33 species of Myrtaceae in Laos PDR are enumerated. *Indigofera aralensis* Gagnep. is newly recorded and five *Syzygium* are endemic species in Lao PDR.

Mussaenda species (Rubiaceae) in Thailand

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A taxonomic study of the genus *Mussaenda* in Thailand has been conducted. Herbarium specimens have been examined, accompanied by field work in Thailand. Twenty-three species have been recognized, three of which were introduced as ornamentals. Seven species are known to be endemic to Thailand. The enlarged creamy-white petaloid calyx lobes, bifid interpetiolar stipules and distyly are common characters for the genus. In the native species, only one calyx lobe was developed into a petaloid, while all five in the ornamentals were enlarged.

A preliminary study of phylogenetic relationships in Thai Vernonieae (Asteraceae)

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The large and widespread tribe Vernonieae (Compositae) is well represented in Thailand with numerous endemic species in several genera (i.e. *Iododcephalus*, *Camchaya*, *Koyamasia*, *Vernonia*). *Vernonia* is the largest of these genera with >30 species in Thailand. Relationships among these taxa are poorly understood, in large part due to the highly variable and overlapping nature of most morphological characters on which all past taxonomic treatments have been based. In this study we explore the phylogenetic relationships among a selection of Thai Vernonieae using sequences from chloroplast (*trn*LC-F, *ndh*F) and nuclear DNA (ITS). Preliminary data identified several strongly supported clades within *Vernonia*. Although no taxonomic recommendations have yet been made, the data provide additional evidence for the removal of a number of species from that genus, as suggested by Robinson (1999). Pollen morphology and growth habit changed over the phylogenetic tree suggesting that the annual habit and triporate pollen were derived characters.

The genus *Ficus* L. in the northeast of Thailand

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The taxonomy of the genus *Ficus* in the northeast of Thailand was studied between August 2005 and March 2008. Six subgenera and 47 species were enumerated. Keys to subgenera and species were constructed. Ecological and distributional data, vernacular names, photographs and line drawings are provided. The habits, leaves and syconia present a number of taxonomic characters useful for classifying the genus into subgenera and species. Leaf anatomy of 10 species was investigated. Some anatomical characters could be useful for the identification of *Ficus* species, *i.e.*, the position and number of cell layers of palisade, presence of an hypodermis, cuticle pattern, intercellular spaces of spongy cells and dermal tissue system of petioles. Pollen morphology of 12 species was examined by light microscopy. The pollen is generally very small to small (7.00–13.50 µm), isopolar, bilaterally symmetric with 2(–3) pores. The shape is mainly elliptic or oblong rarely globose or triangular in polar view. Pollen features do not provide good taxonomic evidence.

Genetic diversity and biology of *Sirindhornia* (Orchidaceae)

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Sirindhornia is a beautiful rare terrestrial orchid genus. It comprises three species: *S. pulchella* endemic to Doi Chiang Dao, Chiang Mai province; *S. mirabilis* endemic to Doi Hua Mot, Tak province; and *S. monophylla* distributed longitudinally from southern China (Yunnan) through eastern Myanmar and western Thailand. Doi Chiang Dao and Doi Hua Mot are, nowadays, becoming more well-known by tourists. The number of visitors has been increasing every year. Affected by tourism and some local impacts, e.g., deforestation, cattle feeding, and forest burning (for hunting, mushroom collecting etc.), all *Sirindhornia* are extremely disturbed and at risk of extinction. The only way to protect these rare orchids is to understand their natural histories in the wild.

The project proposed here aims to study mainly the biology and ecology of this small orchid genus from many different angles, e.g., distribution, flowering, fruiting, reproductive system, pollination, propagation, and relationships between the orchid and mycorrhizal fungi, which is important for seed germination. The project also includes studies of genetic diversity within each population using molecular methods. All results and information from this research will be analyzed and then used to propose a sustainable conservation strategy in the future.

A taxonomic study of Orchidaceae at Doi Phahom Pok, Doi Phahom Pok National Park, Chiang Mai Province

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A taxonomic study of Orchidaceae at Doi Phahom Pok, Doi Phahom Pok National Park, Chiang Mai Province, was carried out by surveying and collecting specimens from March 2006 to December 2007. The specimens were identified using taxonomic literature and described, supported by line drawing illustrations, photographs, vernacular names, and ecological data. Keys to the genera and species were constructed. There were 33 genera and 85 species of orchids recorded in this study of which *Dendrobium* Sw., *Bulbophyllum* Thouars and *Eria* Lindl. are among the most common orchid species represented by 12, 11 and 8 species, respectively. *Ornithochilus yingjiangensis* Z.H.Tsi is a newly recorded species for Thailand. *Bulbophyllum propinquum* Kraenzl., *B. shweliense* W. W. Sm., *Dendrobium dantaniense* Guill., *Porpax lanii* Seidenf., and *Platanthera angustilabris* Seidenf. are endemic species. In addition, 13 species, namely *Bulbophyllum forrestii* Seidenf., *B. khasyanum* Griff., *Cymbidium lowianum* Rchb.f., *C. mastersii* Griff. ex Lindl., *Dendrobium chrysanthum* Lindl., *D. devonianum* Paxton, *D. falconeri* Hook., *D. strongylanthum* Rchb.f., *Liparis regnieri* Finet, *L. resupinata* Ridl., *Monomeria barbata* Lindl., *Platanthera angustilabris* Seidenf. and *Robiquetia pachyphylla* (Rchb.f.) Garay, are threatened orchids.

In Vitro propagation and protocorm cryopreservation of *Phalaenopsis cornu- cervi* (Breda) Blume & Rchb. f.

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The effect of thidiazuron (TDZ) and benzyladenine (BA) on PLBs induction from leaf explants was investigated. It was found that TDZ was superior to BA. The highest number of PLBs per leaf explant was found to be the optimum on ½ MS medium supplemented with 9 µM TDZ with significant differences from other media. The regenerated plantlets were potted in sphagnum moss or brick and acclimatized in the greenhouse. These plants grew well and developed into normal plants after 1 month of transplantation. A 100% survival rate of plantlets was achieved when they were planted on brick. Two-month-old protocorms at the GI 4 stage were cryopreserved in liquid nitrogen by a vitrification method. The protocorms were precultured in MS liquid medium containing 0.5M sucrose for 2 days then loaded in 2M glycerol plus 0.4M sucrose for 20 min. Protocorms were then exposed to PVS2 solution at 25 ± 1°C for 60 min and stored in a liquid nitrogen tank for 1 day. After being recovered from the liquid nitrogen tank and rapidly plunged into a water bath at 45°C for 1 min, the PVS2 solution was replaced by MS liquid medium containing 0.5 ml of 1.2M sucrose for 20 min. The percentage of protocorm survival was 31 ± 1% as measured by Evan's blue. No protocorms survived without vitrification treatments. In addition, protocorm viability showed no differences when stored in liquid nitrogen for 1 hour, 1 day, 1 week, 1 month, 3 months or 5 months.

Diversity of vascular plants on cliffs and rocky ridges of Sankalakhiri range in Betong district, Yala province

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A study on the diversity of vascular plants on the cliffs and rocky ridges of Sankalakhiri range in Betong district, Yala province, was conducted from October 2005 to June 2008. A total of 128 plants species were collected. Of these, 37 species were pteridophytes, three species were gymnosperms and 88 species were flowering plants. The family Orchidaceae was the largest group of plants in the study area and included 28 species. Most plants were facultative epiphytes and had typical xeromorphic features. In addition, there were 13 newly recorded plant species for Thailand, i.e., *Syngramma minima* Holttum, *Willughbeia tenuiflora* Dyer ex. Hook.f., *Hoya imperialis* Lindl., *Elaeocarpus pedunculatus* Wall. ex Mast., *Didymocarpus citrinus* Ridl., *D. cordatus* A. DC. var. *cordatus*, *Henckelia bombycina* (Ridl.) A. Weber, *Paraboea elegans* (Ridl.) B.L. Burtt, *Pachycentria glauca* Triana subsp. *maingayi* (C.B. Clarke) Clausing, *P. hanseniana* Clausing, *Coelogyne prasina* Ridl., *C. testacea* Lindl. and *Geostachys penangensis* Ridl. Plant community types are also briefly discussed. Descriptions and status of each plant species (common, uncommon, rare or endemic) in the study area together with ecological data, localities and distribution ranges of each species are presented as well as photographs and keys to genera and species. Voucher specimens are deposited at the Prince of Songkla University Herbarium (PSU), Department of Biology, Faculty of Science, Prince of Songkla University and the Forest Herbarium (BKF), National Park, Wildlife and Plant Conservation Department, Ministry of Natural Resources and Environment.

The diversity of vascular plants along Bangwan and Tamnang streams in Kuraburi district, Phang-nga province

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A study of the vascular plant diversity along Bangwan and Tamnang streams at Kuraburi, Phangnga province, was undertaken from January 2006 to December 2007. A total of 61 families, 120 genera, and 156 species were collected. The numbers of species of monocotyledons, dicotyledons, and pteridophytes were 51, 92, and 13, respectively. The most common family was the Cyperaceae with 15 species being recorded, followed by the Rubiaceae and Zingiberaceae with 14 and 11 species, respectively. Plant community types along streams are discussed and descriptions, the status of each plant species (common, uncommon, rare or endemic) in the study area together with ecological data, localities and distribution ranges of each species are given. Voucher specimens are deposited at the Prince of Songkla University Herbarium (PSU), Department of Biology, Faculty of Science, Prince of Songkla University and the Forest Herbarium (BKF), National Park, Wildlife and Plant Conservation Department, Ministry of Natural Resources and Environment.

Field surveys of natural populations of *Begonia* in Thailand

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Field surveys of natural populations of the genus *Begonia* (Begoniaceae) were conducted in all parts of Thailand from June 2007 - May 2008. The 30 species recognized so far were collected from various habitats on various substrata, i.e., terrestrial, epiphytic and lithophytic. In all cases, natural populations of *Begonia* occurred only near streams or waterfalls or in humid places such as on moist bark or rocks, from low elevations at about sea level in the eastern part and the peninsula to the summits of mountains over 2,000 m in northern Thailand. All species found were either annual or perennial herbs that appeared in the rainy season. Concerning taxon abundance and distribution, three groups of *Begonia* could be determined, i.e., northern taxa, central taxa and peninsular taxa. Only one species was found all over the country, i.e., *Begonia integrifolia* Dalzell, and another two taxa occurred in two floristic regions (south-eastern and peninsular), i.e., *Begonia sinuata* Wall. ex Meisn. var. *sinuata* and *B. variabilis* Ridl. Otherwise, each taxon was recorded from only one floristic region of Thailand.

Meliaceae of Thailand

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A revision of the family Meliaceae of Thailand, with financial support from the Biodiversity Research and Training Program (BRT), has been conducted for 2 years (2007-2008) of this 3-year project. Our main work is based on botanical collection in the field and study of specimens in herbaria (both Thai and foreign) in order to verify each plant species. So far, 15 genera have been revised primarily from a total of 18 genera. They are *Aglaia*, *Aphanamixis*, *Azadirachta*, *Chisocheton*, *Chukrasia*, *Cipadessa*, *Heynea*, *Lansium*, *Melia*, *Munronia*, *Pseudoclausena*, *Toona*, *Turraea*, *Walsura* and *Xylocarpus*. One important genus from the north, *Pseudoclausena* is considered to be a new genus record for Thailand. The revision of the Meliaceae of Thailand will be completed within 2009 as planned.

Species diversity of vascular plants on limestone in Southeastern Thailand

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A study of vascular plant diversity on limestone in southeastern Thailand was undertaken for 2 years from May 2006 to April 2008. The study sites were located at Khao Chakan, Khao Lueam, Khao Ta Ngok, Khao Wong, Khao Cha-ang Ngonngaen, Khao Cha-ang On and Khao Yai. So far, 1,162 species, 652 genera and 153 families have been determined. The most common families were Euphorbiaceae, Leguminosae and Orchidaceae. Among them, 93 species are restricted to limestone. Two hundred and fifteen species were classified as threatened. At least 6 species may be new to science.

Plant species first discovered in Thailand

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Thailand is situated in the tropical monsoon zone and plant genetic diversity is one of the highest in the world. Many new species have been discovered in Thailand, and this book presents details and photos of some of these new species. There are 7 species named after Thai royalty, namely *Afgekia mahidoliae, Bauhinia sirindhorniae, Magnolia sirindhorniae, Mitrephora sirikitiae, Sirindhornia mirabilis, Sirindhornia pulchella* and *Wrightia sirikitiae*. There are 75 species named in honour of Thailand, such as *Acalypha siamensis, Alyxia thailandica, Artabotrys siamensis, Boesenbergia siamensis, Calamus siamensis, Crinum thaianum, Cycas siamensis, Dasoclema siamensis, Gardenia thailandica, Jasminum siamense, Magnolia siamensis, Magnolia thailandica, Mammea siamensis, Sindora siamensis* and *Vanilla siamensis*. Another 28 species take their name from the localities where they were discovered (provinces, districts, villages, mountains, rivers), such as *Amorphophallus saraburiensis, Gardenia sootepensis, Hydrocotyl chiangdaoensis, Iguanura thalangensis, Impatiens phuluangensis* and *Xyris kradungensis.* There are 57 plants named after their discoverer or someone the author wanted to acknowledge, such as *Adiantum thongthamii, Aglaonema chermsiriwattaniae, Argostemma thaithongiae, Artabotrys vanprukii, Bauhinia winitii, Begonia puttii, Boesenbergia baimaii, Bulbophyllum smithinandii, Gardenia collinsiae, Hoya kerrii, Magnolia garrettii* and *Magnolia rajaniana.* Finally, 37 plants take their name from characters they have, such as *Aristolochia grandis, Artabotrys spinosus, Bauhinia aureifolia, Cyathostemma longipes, Eriocaulon minimum, Jasminum calcicola, Magnolia citrata, Polyalthia viridis* and *Trachycarpus oreophilus.* Many of these new species are endemic or rare and endangered, and steps need to be taken to ensure their conservation for future Thai generations.

Conservation, development and utilization of *Gluta* (Anacardiaceae) in Thailand

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This 2-year project on the conservation, development and utilization of *Gluta* plants began in October 2007, and is studying 11 native species in Thailand. *Gluta* is found in every region in Thailand, in dry dipterocarp forest, dry evergreen forest and in scrub. The fertility of sandy soils and sandstone bed rock areas was very low, relative humidity was very low to medium and the altitude of habitats was 50-400 m. The dominant characters for identifying *Gluta* species are from flowers and fruits. *Gluta ustitata* (Wall.) Ding Hou is the most economically valuable species because of the value of its latex. At full bloom with creamy white flowers in November, it stands out in dry dipterocarp forest in Tak, Lampang, Lamphun, Chiang Mai, Udon Thani, Nakhon Ratchasima and Kanchanaburi provinces. Fruits ripen in February, with 5 large reddish wings that produce a twisting fall similar to that of the fruits of *Dipterocarpus alatus* Roxb.ex G.Don. Seed germination in natural habitats is very low because of the lack of rain, low humidity and fire in summer. Seed germination experiments with various treatments produced more than 50% germination. Seedling cultivation will be done and appropriate techniques developed for farmers.

Development of fragrant flower plants for decoration and essential oil production

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This is the third year of study of the use of fragrant flower species for aromatherapy purposes. The methodology is based on simple techniques and self sufficiency for rural areas. A proposed prototype aims to cultivate fragrant flower plants for massage rooms, herbal incubator rooms, rest areas, fitness parks and toilet zones in petrol stations. The main considerations were flowering period, time of anthesis, number of flowers and aromatic concentration. A poll of 100 people found *Jasminum sabac* to be the most popular mild fragrant flower species, followed by *Tarenna stellulata, Magnolia X alba, Magnolia champaca, Friesodielsis desmoides, Artabotrys hexapetalus, Ixora finlaysoniana, Rosa damascena, Parameria barbata, Oxyceros horridus, Alyxia reinwardtii, Marsdenia floribunda* and *Vallaris glabra*. Of the strong fragrant flower species very suitable for toilet zones in petrol stations, *Wrightia religiosa* was the most favoured, followed by *Murraya paniculata, Polianthes tuberosa, Cestrum diurnum, Gardenia augusta, Crinum asiaticum, Buddleja paniculata,* and *Plumeria obtusa*. Cultivation techniques and maintenance are very important for management over a long period. Cutting, pruning and re-planting at suitable times made them more attractive.