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## Taxonomic revision of Sematophyllaceae (Musci) in Thailand

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A taxonomic treatment of the Sematophyllaceae (Musci) in Thailand was carried out based on more than 1,600 specimens made by Thai collectors and foreigners, including types. An enumeration of this moss family included 24 genera, 105 species, 5 varieties and 1 forma. Among them 13 species and 2 varieties are endemic to Thailand, such as *Acroporium convolutifolium* Dixon, *Acroporium hamulatum* (M. Fleisch.) M. Fleisch. var. *procumbens* (M. Fleisch.) Dixon, *Acroporium secundum* (Reinw. & Hornsch.) M. Fleisch. var. *siamense* Dixon, *Mastopoma subfiliferum* Horikawa & Ando, *Rhaphidostichum leptocarpoides* (Broth.) Broth., *Rhaphidostichum subrevolutum* (Broth.) Broth., *Sematophyllum latifolium* Broth., *Taxithelium clastobryoides* Dixon, *Taxithelium epapillosum* Dixon, *Taxithelium inerme* Tixier, *Taxithelium schmidtii* Broth., *Trichosteleum trachycystis* Broth., and *Wijkia filipendula* (Dixon) H. A. Crum. Nine newly recorded species are reported for the Indochina region. New nomenclatures are proposed for 15 taxa and a lectotype is selected for *Taxithelium arnottii* Thér. & Tixier. There are 3 species, *Papillidiopsis* sp., *Trismegistia* sp. and *Wijkia* sp., for which identification is doubtful. Keys to genera in the family and to species in each genus are provided together with some diagnostics of species and their distributions in Thailand.

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## **Taxonomic revision of *Fissidens* Hedw. (Fissidentaceae: Bryophyta) from seven National Parks in Thailand**

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Twenty-five taxa of *Fissidens* Hedw. with three new records (*Fissidens jungermanniodes* Griff., *F. pseudoceylonensis* Tan & Choy. and *F. schwabei* Nog.) were found in different parts of Thailand. Three hundred and six specimens were collected from seven National Parks (Doi Inthanon National Park, Doi Suthep-Pui National Park, Doi Chiang Dao National Park, Phu Hin Rong Kla National Park, Phu Phan National Park, Khao Yai National Park, and Nam Tok Ngao National Park). Twenty-three species of *Fissidens* were found in dry to moist habitats. Two species only grow on wet rock substrate, viz. *F. geminiflorus* Dozy & Molk. and *F. jungermanniodes* Griff.. The three most common species consisted of *F. ceylonensis* Dozy & Molk., *F. crispulus* Brid. var. *crispulus* and *F. pellucidus* Hornsch. Eighteen taxa are terrestrial; the other seven taxa are either terrestrial or epiphytic.

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

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*Microsorium punctatum* (L.) Copel. occurs naturally in various forest types. It is found from sea level to about 2,800 m altitude and is distributed in the palaeotropics and subtropics. At present, the taxonomic status and boundary of this species is still dubious due to its great variation in leaf form, leaf size and venation patterns. This variation does not match with previously recognized systematic treatments. So, this species group was proposed as a species complex and, therefore, worth investigating. Cluster analysis and canonical discriminant analysis were performed on 707 herbarium specimens of 21 taxa of the *M. punctatum* complex. They are presently deposited at BCU, BKF, BM, K, B, L and P. A total of 28 quantitative and 36 qualitative characters were employed. In cluster analysis, those 21 taxa were separated into eight groups, viz. *M. whiteheadii*, *M. siamensis*, *M. thailandicum*, *M. membranaceum*, *M. glossophyllum*, *M. musifolium*, *M. steerei*, and *M. punctatum*. The eight-cluster grouping is discussed. From the canonical discriminant analysis using the eight-cluster grouping as *a priori* groups, it can be concluded that *M. siamensis*, *M. thailandicum*, *M. membranaceum* are clearly distinct taxa, while *M. musifolium* var. *musifolium*, *M. musifolium* var. *glossophyllum*, *M. punctatum* var. *punctatum*, *M. punctatum* var. *steerei* and *M. punctatum* var. *whiteheadii* are recognized based on the results of this study. The six most important characters that separate the eight species are stipe length, rhizome scale length, primary areole width, number of sori rows between adjacent secondary veins, sori diameter and sori density. These quantitative characters, together with some qualitative characters, were useful in constructing an identification key to these taxa. The differences between the studied taxa are discussed.

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## Multivariate analyses of the fern genus *Lepisorus* (J. Smith) Ching (Polypodiaceae: Pteridophyta) and segregated genera

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*Lepisorus* (J. Smith) Ching s.l. is a fern genus of the family Polypodiaceae. Mostly, it naturally occurs in Africa and tropical Asia reaching to Japan and the Far East of Russia. So far its taxonomic circumscription remains controversial because sometimes it includes or excludes segregated taxa (i.e. *Paragramma* and *Platygyria*). Also, sometimes *Platygyria* is merged with *Neocheiropteris*. This research mainly aims to investigate phenetic relationships, to clarify circumscriptions, and to determine the importance of morphological or anatomical characters for the classification of these taxa. We have performed multivariate analyses including UPGMA clustering and discriminant analyses based on 28 quantitative and/or 29 qualitative characters of both morphological and anatomical characters examined from 492 herbarium specimens. On the basis of the UPGMA, a dendrogram separated all herbarium specimens into three groups with a Gower similarity coefficient of 0.76. Group 1 and group 2 consisted of *Neocheiropteris palmatopedata* Christ and four species of *Platygyria*, respectively, and group 3 consisted of one species of *Paragramma* deeply embedded in *Lepisorus* s.s. These results were similar to those from canonical discriminant analysis. The important characters determined by canonical discriminant analysis that can be used to distinguish the three groups are annulus width, length of the apical part of the lamina, and lamina width. According to these results, *Platygyria*, *Lepisorus* and *Neocheiropteris palmatopedata* Christ. should be recognized as distinct taxa. On the other hand, the genus *Paragramma* should be merged with the genus *Lepisorus*.

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## Biological diversity and ecology of palm species in Phetchabun Province

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The aim of this research was to investigate palm population distributions and species diversity within three conservation areas on Phetchabun mountain. The study was conducted at three sites. They were Thung Saleang Luang National Park (TS), Khao Kho non-hunting area (KK) and Wangpong-Chondaen non-hunting area (WP). Systematic random sampling was utilized for assessment in this study. Experimental plots were circular in shape and 20 meters in diameter. Temporary plots were established on the left and right hand-sides of the base-line at 20 meter intervals. Palm plants were divided into 3 categories; adult, juvenile and seedling. The results revealed that species composition in Thung Saleang Luang National Park and Khao Kho non-hunting area were similar. There were six species in TS and KK, i.e. *Livistona jenkinsiana*, *Calamus palustris*, *C. cf. khasianus*, *Daemonorops jenkinsiana* and *Areca triandra*. Four species were found in WP, *Arenga pinnata*, *Caryota* sp., *Calamus* sp. and rattan (Unknown sp. 1). There were statistically significant differences in density at the three study sites. *D. jenkinsiana* and *A. triandra* had the highest density and they were the dominant species in TS and KK. In WP, *A. pinnata* which was the dominant species, showed the highest value. Environmental factors such as light intensity, altitude, seed dispersal and moisture have affected palm densities. Palm plants showed restrictions in growth in natural conditions, especially *C. cf. khasianus*. Therefore, these are problems for survival and stability in a natural forest environment. Some important species, for example *C. cf. khasianus*, are endemic and will become endangered or extinct in the near future. So, fundamental biological data on this species is essential for forest management planning.

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## Palynology of the family Apocynaceae in Thailand

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Pollen materials from fifty-seven apocynaceous species belonging to thirty-three genera in Thailand were investigated by the acetolysis method. The morphology of the acetolysed pollen grains was studied by means of light and scanning electron microscopes. General pollen morphological descriptions and some photomicrographs of studied species have been made. Pollen grains of most species are isopolar, rarely apolar. The polar area index of pollen grains varied from small (0.35  $\mu\text{m}$ ) to large (0.81  $\mu\text{m}$ ). The circumference of pollen grains in polar view varied from circular to triangular-obtuse or quadrangular-obtuse. The pollen grains can occur in oblate to prolate form, but usually occurred in subspheroidal form. Pollen size formed a gradient varying from small (10-25  $\mu\text{m}$ ) to large (50-100  $\mu\text{m}$ ) size. The most common types of apertures found in most species are colporate and porate. The basic numbers of apertures are three and four, rarely two or more than ten. The exine sculpturing of Apocynaceae pollen is usually smooth psilate with perforation. However, it may be fossulate, verrucate, granulate or reticulate, especially in the interapertural areas. From these results, the pollen grains have some qualitative characters that can be used for recognition of Thai apocynaceous plants at several taxonomic levels, including the two subfamilies Rauvolfioideae and Apocynoideae, the genus *Alyia*, and the two species, *Anodendron paniculatum* A.DC. and *Ichnocarpus polyanthus* (Blume) P.I.Forst..

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## The taxonomy of the family Rhamnaceae in Thailand

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The family Rhamnaceae in Thailand is taxonomically revised. There are 10 genera, comprising 36 species and 41 taxa. Two genera, *Sageratia* and *Scutia*, are new generic records for Thailand. Seven species, *Sageratia filiformis*, *Scutia myrtina*, *Smythea pacifica*, *Ventilago gladiata*, *V. leiocarpa*, *V. oblongifolia* and *Zizyphus kunstlei*, are new to Thailand. Keys to genera and species, and distributional and ecological data are presented.



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## Comparative anatomy of Polygalaceae in Thailand

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The anatomical characters of 25 species from four genera, i.e., 13 of *Polygala*, five of *Salomonina*, one of *Securidaca* and six of *Xanthophyllum*, were studied by the use of the paraffin method, clearing techniques and scanning electron microscopy. The unilacunar with one trace is the typical character of nodal anatomy in this family. Roots of *Salomonina* are distinguishable by the presence of idioblasts and air cavities in the cortex. The four genera can be classified into two groups based on leaf characters. The first group contains *Xanthophyllum* only, which is separated by having tracheoid idioblasts at the ends of veinlets in leaf blades. The second group contains another three genera which is defined by the lack of tracheoid idioblasts. Moreover, leaf epidermal characters, hypostomatic or amphistomatic leaves, presence of papillae, types and shape of hairs, stomatal types, epidermal cell shapes and cuticular ornamentations, and mesophyll characters, numbers of palisade layers and the presence of lysigenous cavities, including the presence of fibre bundle sheaths or bundle caps are significant characters for species identification. Petiole, root and nodal anatomy are not recommended for species recognition. From the presence of druse crystals in the mesophyll of perianth segments of *Polygala* and *Salomonina*, all of *Polygala* section *Polygala* can be distinguished from others and, in addition, the cuticular ornamentation of their inner sepals in some species is also helpful for species determination. In the genus *Salomonina*, the presence of papillae and cuticular ornamentation on the outer surfaces of capsules are supposed to be helpful features in species identification.

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## The taxonomy and utilization of the genus *Indigofera* L. (Leguminosae) in Thailand

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The taxonomy of the genus *Indigofera* L. in Thailand was studied. Plant specimens were investigated from herbaria and collected from the field. Thirty-four species with one subspecies and three varieties were recognised. Descriptions, illustrations and keys are provided. *Indigofera aralensis* and *I. scabrida* are new records for Thailand. Four endemic species were found, namely *I. hendecaphylla* var. *siamensis*, *I. kerrii*, *I. laxiflora* and *I. thailandica*. Two unknown species are expected to be new species. Acetolysed pollen of ten species was investigated using light microscopy and scanning electron microscopy. The pollen is monad, isopolar, small to medium in size, prolate spheroidal, subprolate or perprolate in shape and tricolporate, with a perforate, reticulate or rugulate exine surface. The epidermal anatomy of leaflets of eight species was investigated using the peeling method technique. Trichome types, not stomatal types, shapes of areoles and veinlet endings inside areoles, clearly supported the macromorphological classification of species.

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## **The genus *Dioscorea* L. (Dioscoreaceae), a major food plant of the Sakai tribe of the Banthad Range, Peninsular Thailand**

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Thirteen species of *Dioscorea* at the Banthad Range, Peninsular Thailand, were found. Morphological characteristics of all species of *Dioscorea* as well as their ethnobotanical values in terms of major food plants of the “Sakai” tribe have been studied using morphometric methods. Twenty morphological characters from eight hundred individuals in three selected study sites were measured. The data were analyzed using DCA, Twinspan and CCA. Ethnobotanical data of *Dioscorea* such as harvesting, toxin reduction and consumption are presented. Nutritional compositions of some *Dioscorea* tubers are also reported.

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## Systematics of the subtribe Ischaeminae and Rottboelliinae (Poaceae) in Thailand

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A preliminary taxonomic account of the subtribes Ischaeminae and Rottboelliinae in Thailand are presented. So far, 14 genera, 50 species and 2 infraspecific taxa are enumerated and described. Among these, *Ischaemum* (13 species and 2 infraspecific taxa), *Eremochloa* (12 species) are the two largest genera from the study. It is expected that five species are newly recorded for the country or probably new to science. Epidermal peels and transverse sections of leaf-blades have also been investigated in 25 species of the 14 genera from the two subtribes. The diagnostic anatomical characters include morphology of epidermal cell walls of the long cells in the intercostal zone, shape of subsidiary cells and silica bodies, macro-hairs, papillae, prickles, position of stomata, midrib and keel bundles, rib and furrows on the adaxial surface, shape and distribution of bulliform and colourless cells, and types of bundle sheath cells. It is evident that leaf anatomical characters are taxonomically useful in classification at the generic levels. Phylogenetic analyses of the two subtribes were conducted based on non-coding chloroplast DNA *trnL* intron and *trnL*-F spacer and nuclear ribosomal internal transcribed spacer (ITS) sequence data. Maximum Parsimony analyses were conducted using PAUP\* 4.0b10. The results of analyses are in progress.

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

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Taxonomic studies on Amaryllidaceae, Asparagaceae, Boraginaceae, Piperaceae, Polygonaceae and Eragrostideae (Poaceae) in Thailand and *Indigofera* L. (Leguminosae) and Myrtaceae in Lao PDR have been conducted since July 2006. Specimens were studied from both herbaria and the field. Nine genera and 18 species in Amaryllidaceae, one genus and five species in Asparagaceae, 10 genera and 37 species in Boraginaceae, three genera and 40 species in Piperaceae, six genera and 27 species in Polygonaceae, nine genera and 58 species in Eragrostideae, 18 species in *Indigofera* and five genera and 28 species in Myrtaceae are enumerated. Descriptions, photographs, vernacular names, distributions and ecological information are provided.

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## A taxonomic revision of the genus *Ficus* L. in Northeastern Thailand

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The genus *Ficus* L. in the northeast of Thailand is revised. Morphological characters are discussed. Anatomical and palynological aspects are briefly reviewed. Six subgenera and 44 species are recognized; five of these are introduced to Thailand. Artificial keys to subgenera and species, descriptions, photographs, line drawings, distributional and ecological data, and plant use information are presented.

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## Taxonomy of some figs and their pollinators

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Taxonomic studies of some Figs (*Ficus*) and their pollinators were conducted from June 2004 to June 2007 at Chiang Mai and Lumphun Provinces in Thailand. Twenty-two species of fig trees were classified to 10 monoecious and 12 dioecious plants. Some fig trees such as *F. benjamina* Linn., *F. hispida* Linn.f. and *F. racemosa* Linn. are commonly found in both lowland and higher areas, while others survive in specific habitats, e.g., in limestone areas. These species are *F. anastomosans* (Walls) Corner and *F. anserina* Corner; which can be found in small populations. The study revealed a large number of fig wasps found in each syconium, but only one species functioned as a pollinator. The pollinators studied were identified to 20 species. *Ceratosolen emarginatus* Mayr occurred in both *F. auriculata* Lour and *F. oligodon* Miquel. In this study we could not find any pollinators of *F. pumila* and *F. rumphii*. Some fig wasps are competitors and some are parasites of pollinators.

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## Local knowledge in utilization of the family Fagaceae by communities in Upper Northern Thailand

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This research project entitled “Local Knowledge in Utilization of the Family Fagaceae of Communities in Upper Northern Thailand” aims to understand local knowledge on the uses of the Family Fagaceae and to gain local knowledge-based information on the Family Fagaceae for further conservation strategy development. Data was collected in Chiang Rai, Chiang Mai and Mae Hong Son Provinces, Northern Thailand. It was found that people in upper northern Thailand have interactions with the Family Fagaceae in various dimensions including: 1) utilization of edible fruits for household consumption such as fruit fly, flour and food soup, and bark of some species is used for chewing with betel nuts, 2) using stems and branches for firewood, for mushroom media, house construction, 3) utilization for financial purposes such as selling fruit, charcoal, flowers, and bark, 4) utilization as medicine, for example, boiling leaves and bathing for curing rashes, and branches to lie near the fire after giving birth, 5) using plants for ritual traditional and cultural events and, 6) use as associated trees for traditional conservation farming of indigenous tea <miang>.



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## The reproductive ecology of *Litsia glutinosa* and seed quality of some economic trees in the Lauraceae

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This study was carried out during the year 2004 – 2005 at Nong Rawiang forest, Nakhon Ratchasima. The objectives were focused on the phenology and pollinators of *Litsia glutinosa*, and also on pollen efficiency, reproductive success, seed dispersal, and seed germination of *L. glutinosa* in a natural site, and to test seed quality of *L. glutinosa* and *L. cubeba*. The results showed that growth and development of *L. glutinosa* flowers starting from visible size to the time of anthesis was 34 and 30 days in male and female flowers, respectively. The proper time of anthesis was in June. Fruiting occurred in August to September and fell in October. Pollen viability and germination rates were 82% and 39%, respectively. *Eristalis arborum* Fabr. and *Chrysomya* sp. were the most frequent and dominant flower pollinators. The first pollinator species preferred male flowers while the latter favored female flowers. The peak visitation time to male and female flowers were 8.00 a.m. and 3.00 p.m., respectively. Reproductive success of *L. glutinosa* was 7.4% and seeds were dispersed mostly by birds. *L. glutinosa* and *L. cubeba* had seed viability more than 88%. A standard germination test of *L. glutinosa* with seed stored for 6 months was 72%, whereas no seed germinated for *L. cubeba* in all experiments. Germination rate of *L. glutinosa* in the natural site during June 2004 as given by the number of seedlings was very high, suggesting that seed production had high success in the previous year. However, no seedlings of this species were found in the survey of June 2005.

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## Morphometrics and molecular systematics of the genus *Afgekia* Craib (Fabaceae)

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*A. sericea* Craib, *A. mahidolae* Burt et Chermisrivathana and *A. filipes* (Dunn) Geesink are 3 species in the genus *Afgekia* Craib (Fabaceae) according to a recent classification system. *A. sericea* and *A. mahidolae* are morphologically similar, while *A. filipes* is rather different and also has some characters similar to those found in the closely related genus, *Callerya* Endl.. These discrepancies have led to the uncertain taxonomic status and unsuitability of species treatments in this genus. Therefore, this research aims to explore the taxonomic status of species in the genus *Afgekia* based mainly on morphometric and molecular data. In this morphometrics study, 29 quantitative characters and 1 qualitative character were analyzed by means of Cluster Analysis and Canonical Discriminant Analysis. The results showed that *A. sericea* and *A. mahidolae* were always placed in the same group, while *A. filipes* was distinctly separated into another group. Likewise, the results of molecular systematics from both RAPD and DNA sequencing analyses agreed with the results from morphometric study. A close genetic and phylogenetic similarity between *A. sericea* and *A. mahidolae* was observed. These two species are sister taxa which are derived from the same ancestor. In contrast, *A. filipes* is not in a section of *Afgekia* and should not belong to this genus. The most suitable genus to place *A. filipes* is likely to be *Callerya*. However, the genus *Callerya* itself requires further investigation for clearer delimitation and proper definition of the genus.

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## Taxonomy and molecular relationships of *Goniothalamus* (Blume) Hook. f. & Thoms. and palynology of the Tribe Mitrephoreae (Annonaceae) in Thailand

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Twenty specimens of *Goniothalamus* in Thailand were collected, 14 of which were identified and 6 remain unidentified. Among these are 5 new records for Thailand, namely *G. elegans*, *G. cheliensis*, *G. repevensis*, *G. sawtehii* and *G. umbrosus*. Many characters are 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 indumenta. 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 to 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 proposed by Bân.

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## Molecular phylogeny of the genus *Artabotrys* (Annonaceae)

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Standard laboratory methods of extraction, amplification and cycle sequencing were applied. A parsimony analysis of *ndhF*, *trnL-F*, *psbA-trnH* and *AP3* nuclear gene DNA sequences representing 24 species of *Artabotrys* including African and Asian species were performed. The preliminary phylogeny reconstruction showed that the genus *Artabotrys* is monophyletic with strongly supports. Within the monophyly *Artabotrys* clade two major clade are recognized with good bootstrap support, (A) African monophyly clade and (B) Asian+African clade respectively, but the relationships among species are not good resolved. This analysis suggests that the monophyly African species clade seem to be a common ancestral of Asian species. The further research is necessary to clarify relationships within Asian species by add more species sampling.

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## **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 1 year from May 2006 to April 2007. The study sites were located at Khao Chakan, Khao Lueam, Khao Ta Ngok, Khao Cha-ang Ngonngaen, Khao Cha-ang On and Khao Yai. So far, 1,149 species, 653 genera and 153 families have been determined. The most common families were Leguminosae, Euphorbiaceae and Orchidaceae. Among them, 82 species are restricted to limestone. One hundred and seventy-nine species are classified as threatened. At least 3 species may be new to science.

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## Diversity of vascular plants on the 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 February 2007. A total of four hundred and eighty-eight specimens were collected. Thirty families, fifty-two genera and eighty-two species of vascular plants were identified. Among these, thirty species in fourteen families and nineteen genera are pteridophytes, and fifty-two species in sixteen families and thirty-three genera are flowering plants. Family Orchidaceae is the largest group of plants in the area and includes twenty-five species. Most plants are facultative epiphytic-lithophytic plants. In addition, there were six newly recorded plant species for Thailand, i.e. *Syngramma minima* Holttum, *Coelogyne prasina* Ridl., *Coelogyne testacea* Lindl, *Dendrobium metrium* Kraenzl., *Hoya imperialis* Lindl. and *Pachycentria glauca* Triana subsp. *maingayi* (C.B.Clarke) G.Clausing Plant community types are also briefly discussed. Descriptions, the status of each plant species (common, endemic, threatened, rare) together with ecological data, localities and distribution ranges of each species are presented as well as photographs/drawings of selected species and keys to genera and species in the study areas. Voucher specimens are deposited at Prince of Songkla University Herbarium (PSU-Herbarium), Department of Biology, Faculty of Science, Prince of Songkla University and the Forest Herbarium (BKF), Department of National Parks, Wildlife and Plant Conservation, Ministry of Natural Resources.

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## Diversity of vascular plants along Bangwan and Tannang streams in Kuraburi District, Phang-nga Province

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The biodiversity crisis threatens to destroy much evidence of evolutionary history before it has been discovered or documented. Many plant species have already become extinct, rare, or endangered because habitats and plant distribution lines were threatened. Plant communities along streams, already rare in peninsular Thailand, are very interesting not only in terms of biodiversity, but also because they are buffer habitats between terrestrial communities and aquatic communities (fresh-water). The investigation of native plant diversity in the plant communities along streams in peninsular Thailand is necessary before they are lost completely from their original habitats in the near future. Kuraburi district in Phang-nga is one of those interesting localities for studying such plant diversity along streams. Not only are there short unexplored streams in terms of plant diversity, i.e. Klong Bangwan and Klong Tam-nang, but also the district falls in the range of the well-known eco-tone of the “Kra Isthmus”. Though most of the native plant communities have been eliminated, remnants of natural plant communities along streams left as isolated patches might provide interesting data on native plant species found in these interesting natural habitats. The objective of this study was to investigate the diversity of vascular plants along streams. Vascular plant specimen collections have, so far, been made once a month from October 2006 to September 2007. Identification to species level, if possible, and descriptions of each species together with photographs have been done. Vouchers specimens will be deposited at the Prince of Songkla University Herbarium (PSU), Hat Yai, Songkla, and the Forest Herbarium (BKF) in Bangkok.

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## Development of fragrant flower plants for the purposes of decoration and essential oil production

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A study, in its 2<sup>nd</sup> year, of 30 rare and fragrant flower species for developing them for ornamental purposes found that *Tarenna stellulata* and *Magnolia champaca* “Champa Thong” were very suited as pot plants whereas *Friesodielsia desmoides* and *Uvaria grandiflora* var. *flava* were suited to be outdoor climbing plants. Dominant species for outdoor trees were *Goniothalamus laoticus*, *Gardenia sootepensis*, *Gardenia thailandica*, *Mitrephora winitii* and *Mitrephora sirikitiae*. The study on essential oils for pot pourri production found that dried flowers or dried fruits of 10 rigid, light-weight and stable species, such as *Combretum quadrangulare*, *Getomia floribunda*, *Zollingeria dongnaiensis*, *Sphenodesme mollis*, *Anisoptera scaphula*, *Dipterocarpus intricatus*, *Shorea roxburghii*, *Shorea siamensis*, *Terminaria glaucifolia* and *Berrya mollis*, were suitable.



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## The family Gramineae in Phu Rua National Park, Loei Province

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The taxonomy of the family Gramineae in Phu Rua National Park, Loei Province, was studied. A field collection was made between July 2004 and July 2006. Five subfamilies, 61 genera and 102 taxa are enumerated. *Eragrostis* Wolf and *Digitaria* Haller had the highest number of species found in the area. Descriptions, keys to genera and species, photographs and line drawings are provided. The distribution of the family in the area was investigated. They are found in both forest shade and open areas, on marshy places and rock platforms in Pine, Dry Dipterocarp, Evergreen and Mixed Deciduous forests. Leaf epidermis of two genera and four species were also studied. The presence of papillae and silica-bodies can be used to distinguish between *Heteropogon contortus* (L.) Roem. & Schult. and *H. triticeus* (R.Br.) Stapf ex Craib, whereas the shape of sinuous on the periclinal wall and the length of sinuous on the long upper epidermal cells can be used to distinguish between *Schizachyrium brevifolium* (Sw) Nees ex Büse and *S. sanguineum* (Retz.) Alston.

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## **Genetic characterization of weedy rice (*Oryza sativa* f. *spontanea*) populations found in the Thai Hom Mali Rice fields of northeastern Thailand**

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Weedy rice (*O. sativa* f. *spontanea*) is a major weed in the Hom Mali rice production areas of Thung Kula Ronghai in northeastern Thailand. Weedy rice and Hom Mali rice intercross because they are the same biological species. The aims of this study are to characterize populations of weedy rice. A collection of 125 weedy rice plants collected from six rice fields of the region served as samples. Panicle and flag leaves of each sample were collected. Seeds were scored for four morphological traits and amylose content was determined. The chloroplast ID sequence and *wx* microsatellite allele of the weedy rice population were analyzed. Variations were observed in the weedy rice seed morphotypes, amylose content, and two loci of DNA markers. Weedy rice populations from the Thung Kula Ronghai region in northeastern Thailand vary considerably in both seed morphological traits and genetics. These weedy rice populations most probably originated from hybridization between cultivated rice (*O. sativa*) and its wild relative (*O. rufipogon*).

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## 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 the largest species of seagrass that is generally found in the tropics including Had Chao Mai National Park, Trang. They grow in dense patches, in which plants may be involved in intraspecific competition. The aim of this study is to investigate the effects of density of *E. acoroides* on growth, recruitment and reproduction. The experiment is being carried out in a monospecific meadow of *E. acoroides* by placing ten permanent quadrats (0.25 m<sup>2</sup>) with each density. Four densities of *E. acoroides*, were used, i.e., 100% density (35 shoots/ quadrat), 50% density (18 shoots/ quadrat), 25% density (9 shoots/ quadrat) and 10% density (4 shoots/ quadrat); the density was manipulated by cutting the shoots at the leaf bundle meristems. Surface area, number of new shoots, fruits and flowers have been recorded. The experiment has been carried out since August 2006 and will be completed in August 2007. The results show that the highest recruitment rate was found at 10% density, while the lowest was found at 100% density. Only at 25% density did flowers occur in all months. In addition, there was variation in leaf area and numbers of leaves; the highest values were found at 10% density. This suggested that intraspecific competition might have occurred.

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## Comparative anatomy and micromorphology of nutlets of *Eleocharis* R. Br. and *Mapania* Aubl. (Cyperaceae) in Thailand

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The comparative anatomy of bracts, sheaths, culms and roots of nine species and ten taxa of *Eleocharis* and of leaves, cataphylls, culms, rhizomes and roots of five species of *Mapania* was investigated by an epidermal peel, clearing technique and transverse sections in order to identify good taxonomic characters. The two genera are different in types of silica bodies, the presence or absence of papillae, types of bundle sheaths, the shapes of cells and sclerenchyma strands in ground tissues. Micromorphology of nutlets of nine species and ten taxa of *Eleocharis* and five species of *Mapania* was studied and compared using scanning electron microscopy. The studied taxa were classified into 4 groups based on the epidermis of the nutlet inner wall and presence or absence of cell lumens as follows: (1.) reticulate surface without cell lumen, *E. acutangula* (Roxb.) Schult., *E. congesta* var. *japonica* (Miq.) T. Koyama, *E. geniculata* (L.) Roem. & Schult., *E. ochrostachys* Stued. and *E. tetraquetra* Nee in Wight; (2.) reticulate surface with lumen pit, *E. dulcis* var. *dulcis* (Burm.f.) Hensch and *E. spiralis* (Rottb.) Roem. & Schult; (3.) reticulate surface with lumen depression, *E. dulcis* var. *tuberosa* (Roxb.) T. Koyama, *E. macrorrhiza* T. Koyama and *E. retroflexa* ssp. *chaetaria* (Roem. & Schult.) T. Koyama; and (4.) sculptured surface without cell lumen, *M. cuspidata* (Miq.) Uittien, *M. enodis* (Miq.) C.B. Clarke, *M. kurzii* C.B. Clarke, *M. palustris* var. *palustris* (Hassk. ex Steud.) Fern.-Vill. & Naves and *M. tenuiscapa* C.B. Clarke. Furthermore, shape, size and the configuration of the anticlinal wall provide significant characters for the groups' identification.

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## Genetic variation in *Kaempferia* in Thailand: evidence from chloroplast DNA sequences of *psbA-trnH* and *petA-psbJ* spacers

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Eighteen accessions of *Kaempferia*, representing 8 extant species (*K. rotunda*, *K. pulchra*, *K. grandifolia*, *K. marginata*, *K. elegans*, *K. parviflora*, *K. candida*, and *K. roscoeana*) and 4 unidentified taxa (*Kaempferia* sp.1-4) were examined by sequencing of *psbA-trnH* and *petA-psbJ* spacers. Five species outgroups (*Curcuma* sp., *Smithatris supaneanae*, *Scaphochlamys biloba*, *Scaphochlamys minutiflora*, and *Stahlianthus* sp.) were also included. The PCR products of *psbA-trnH* were approximately 800 bp across all investigated samples, except for the *psbA-trnH* of *S. biloba*, which was about 400 bp in length. The PCR products of *petA-psbJ-psbL* of all samples were about 1,200 bp, except for those of *Curcuma* sp., *S. biloba*, and *S. minutiflora*, which were approximately 700, 900, and 900 bp in length, respectively. Pairwise divergence of *psbA-trnH* ranged between 0.00 and 2.07% (*K. parviflora* and *S. biloba*) while pairwise divergence of partial *petA-psbJ* ranged from 0.00 to 3.42% (*K. parviflora* and *Curcuma* sp.). Intraspecific sequence variation was not observed in 3 species, namely *K. candida*, *Kaempferia* sp.1 (Phor Suatam) and *Kaempferia* sp.3 (Phor Saraburi), for which more than 1 specimen was available. In contrast, there was sequence variation between 2 populations of *K. elegans* and among 3 populations of *K. marginata*. Furthermore, additional *Kaempferia* species and closely related genera will be collected and phylogenetically analyzed.

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## Taxonomic study of Orchidaceae in 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 survey and collecting specimens from March 2006 until July 2007. Morphological characters were investigated, described, and supported by line drawing illustrations, photographs, vernacular names and ecological data. Plant specimens were identified using taxonomic keys and comparing with herbarium specimens kept in The Forest Herbarium (BKF), The Bangkok Herbarium (BK) and The Herbarium of Queen Sirikit Botanic Garden (QSBG). There were 33 genera and 85 species of orchids found in this study, of which species of *Dendrobium*, *Bulbophyllum* and *Eria* were the most common, being comprised of 12, 11 and 8 species, respectively. *Ornithochilus yingjiangensis* Tsi is a newly recorded orchid species for Thailand. Moreover, *Porpax lanii* Seidenf., *Dendrobium alterum* Seidenf. and *Platanthera angustilabris* Seidenf. are endemic. In addition, *Bulbophyllum forrestii* Seidenf., *B. khasyanum* Griff., *Cymbidium lowianum* Rchb.f., *C. mastersii* Griff. ex Lindl., *Dendrobium chrysanthum* Lindl., *D. devonianum* Paxt., *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 13 threatened orchids.

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## **Conservation of *Phalaenopsis cornucervi* (Breda) Blume & Rchb. f. protocorm by cryopreservation**

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The seeds of *Phalaenopsis cornucervi* (Breda) Blume & Rchb. f. were tested for viability using 0.2% (w/v) 2, 3, 5-Triphenyl tetrazolium chloride (TTC) and it was found that seed viability was 60%. The effects of media formulae on seed germination, growth index, number of protocorms and plantlets were studied. Seeds were sown on MS (Murashige and Skoog, 1962) and VW (Vacin and Went, 1949) liquid medium either with or without 15% CW (coconut water either filtered or autoclaved). After culturing for 8 weeks, results showed that MS liquid medium supplemented with 15% CW promoted growth from seed germination to plantlets. The greatest induction of protocorm-like bodies (PLBs) was obtained in MS liquid medium supplemented with 15% CW and without sucrose. MS solid medium containing 15% CW was suitable for induction of protocorm to plantlets with significant differences from other media. Activated charcoal at the concentration of 0.3% (w/v) significantly increased the numbers of leaves and roots. After 6 months in culture, protocorms developed into complete plantlets. The regenerated plantlets were potted in sphagnum moss or brick and acclimatized in a green house. These plants grew well and developed into normal plants after 4 weeks of transplantation. A 100% survival rate of plantlets was achieved when the plantlets were planted on brick.

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## ***In vitro* propagation of *Cymbidium finlaysonianum* Lindl. and conservation of protocorms by artificial seed technology**

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The viability of *Cymbidium finlaysonianum* Lindl. seeds was 83.83% when tested using 0.5% Evan's blue. Seeds were cultured on modified VW (Vacin and Went, 1949) medium and protocorms were obtained after two months in culture. These protocorms were chopped prior to transfer to liquid VW medium supplemented with 15% coconut water. Abundant newly formed protocorm-like bodies (plbs) were observed after two weeks in culture, while 80% of the rhizome region of non chopped protocorms initiated plbs within 45 days. When these plbs were transferred to VW liquid medium supplemented with 0, 1, 5, 10, 15 and 20 ppm chitosan, results revealed that VW medium containing 15 ppm chitosan produced 5.2 plbs per piece. Protocorm and plbs developed into plantlets when they were subcultured onto modified solid VW medium supplemented with 0.2% (w/v) activated charcoal.



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## **Valuation of fishery and non timber forest products of seasonally flooded forest in the Lower Songkhram River Basin, Nakhon Phanom**

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The objective of the study “Valuation of fishery and non timber forest products of seasonally flooded forest in the Songkhram River Basin, Nakhon Phanom,” was to estimate the direct use value of fishery and non timber forest products from seasonally flooded forest in the Lower Songkhram River Basin, Nakhon Phanom, by the market price method. A questionnaire was used to collect data by interviewing respondents who were randomly selected from local villages in the study area. The sample size was calculated by the quota sampling method at 20 percent of households in each village. The total sample size was 261 selected from 10 villages in Sri Songkhram District, Nakhon Phanom. Values of NTFP’s from seasonally flooded forest in the Lower Songkhram River Basin, Nakhon Phanom, comprised 7 groups as follows: value of wild vegetable plants was 354,540 baht/year, value of edible mushrooms was 1,820,600 baht/year, value of bamboo shoots was 421,560 baht/year, value of firewood was 523,473 baht/year, value of fodder was 1,915,204 baht/year, value of edible insects and ant eggs was 355,228 baht/year and the value of medicinal plants was disregarded because the volume of medicinal plants that villagers utilized was relatively small. The total value of NTFP’s of seasonally flooded forest in the study area was 5,390,606 baht/year. The value of fishery products was 4,632,670 baht/year. The total value of fishery products and NTFP’s of seasonally flooded forest in the Songkhram River Basin, Nakhon Phanom, for 261 households was thus equal to 10,023,276 baht/year.

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## **Seasonally flooded forest and household subsistence livelihood: a case of the Lower Songkhram River Basin**

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This study aimed at determining the contribution of seasonally flooded forest to the subsistence of local households and exploring factors affecting household subsistence livelihoods. Structured questionnaire and in-depth interview were used as key tools for data collection. The sampled population consisted of 269 household heads in 12 villages located on both sides of the lower Songkhram River in Nakhon Phanom Province. Data collected during October 2005 – January 2006 were analyzed using the Statistical Package for Social Sciences (SPSS). Most sampled households had subsistence livelihoods, with 61.3%, 69.5% and 69.1% of the households having sufficient rice, vegetable and fish consumption, respectively. Amounts of rice, vegetable and fish products that households could harvest from seasonally flooded forest areas per year exceeded the actual amounts consumed by households per year. 82.5% of the households consumed rice more than the standard (Department of Health: 1997). However, 85.1% and 97% of households consumed less vegetables and fish, respectively, than the standard (Department of Health: 1997). This was despite them having harvested sufficient amounts; rather they sold the surplus products. Factors affecting the contribution of seasonally flooded forest to household subsistence livelihoods included gender of the household head, number of years in school, number of household members, size of harvesting area, distance from house to the flooded forest, number of household occupations, type of supplementary occupation, and different villages. It was concluded that seasonally flooded forest provided a significant contribution to household subsistence and livelihood. Any change or damage to the natural characteristics of seasonally flooded forest of the lower Songkhram River Basin should be avoided and carefully thought out.

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## **Current knowledge of wild plants utilized by hilltribes in Northern Thailand**

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The objective of this project is to investigate and review current knowledge on wild plants utilized by hilltribes in northern Thailand. The study covered the areas where Royal Projects were located and included four Royal Research Centers and thirty-three Royal Project Development Centers in Lumpoon, Chiang Mai, Chiang Rai and Mae Hong Son Provinces. The areas are inhabited by Lahu, Karen, Shan, Yao, Palau, Lisu, Akha, Hmong, Lawa, Yunnanese and Mien hilltribes. The investigation covered hilltribe knowledge and a search of current literature for information on wild plants, and scientific and vernacular names, plant descriptions, propagation, distributions, hilltribe, native and foreign uses, nutritive, medicinal, and plant protective properties and chemical constituents have been included where possible. For the third phase of this work, a total number of 364 plant species used by hilltribes were completed and have been covered in this report.

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## Exploring grade 12 students' understanding of species diversity concepts

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This research explored students' understanding of species diversity concepts. Twenty-three Grade 12 students (age 17-18 years old) from a public secondary school in Rachaburi province were presented with a 14 item paper-and-pencil concept survey about species diversity. The concepts were developed to investigate the following areas: organismal classifications, species, and conservation. The items were open-ended questions. Data from the concept survey were analyzed and categorized into 5 groups, namely sound understanding, partial understanding, partial understanding with specific misunderstanding, specific misunderstanding, and no understanding. The results revealed that most students had specific misunderstanding of organismal classifications that prefer to classify organisms using the criteria of habitat. The students expressed the concepts related to their prior experience and everyday use of these terms. For the concepts of species and conservation, most students had partial understanding of these concepts. The results of this study will be beneficial to science teachers and educators and to teacher professional development in teaching and learning species diversity concepts.