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ป่าเมฆ – เขานัน

Liverwort diversity at the Summit of Khao Nan, Khao Nan National Park, Nakhon Si Thammarat Province

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The summit of Khao Nan of Khao Nan National Park in Nakhon Si Thammarat Province of Thailand is situated *ca.* 1,438 meters above mean sea level. The vegetation at the peak is classified as cloud forest because it is covered with mist nearly all year round, and is thus suitable as bryophyte habitat. Thus far, few studies have been taken to study bryophyte diversity in the cloud forests of Thailand. Therefore, the diversity of liverworts at the summit of Khao Nan was investigated from January 2006 to June 2007. Exploration and field collection of liverworts were carried out at elevations ranging from 1,000 to 1,438 m. In total, 539 specimens were enumerated comprising 71 species in 28 genera in 14 families. With respect to their habitats, it was found that they are epiphytic, terrestrial, and lithophytic. Among 14 families, ten families, *viz.* Aneuraceae, Frullaniaceae, Geocalycaceae, Jungermanniaceae, Lejeuneaceae, Lepidoziaceae, Plagiochilaceae, Radulaceae, Schistochilaceae and Trichocoleaceae, were represented at this summit by 2 or more species. In terms of species richness, the family Lejeuneaceae was the richest represented by 15 species in 9 genera, including *Chilolejeuenea* (1), *Cololejeunea* (1), *Colura* (1), *Drepanolejeunea* (4), *Leptolejeunea (1)*, *Lopholejeunea* (2), *Metalejeunea* (1), *Spruceanthus* (1) and *Thysananthus* (3). Moreover, of all liverwort species found, those which had the highest relative abundance were members of *Bazzania* found at elevations from 1,000 m to the summit of Khao Nan.

Pteridophyte diversity in tropical lowland rainforest of Khao Nan National Park, Nakhon Si Thammarat Province, Thailand

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An enumeration of the pteridophytes in tropical lowland rainforest of Khao Nan National Park, Nakhon Si Thammarat Province, is presented. This is the first report for the area. The site is composed of tropical lowland rain forest located in southern Thailand. A total of 418 specimens were collected. They were classified into 27 families, 67 genera, 204 species, 1 subspecies and 7 varieties. Selaginellaceae had the highest number of species among fern allies, i.e. 10. Three families of ferns, namely Polypodiaceae, Dryopteridaceae, and Aspleniaceae, were among the common families, while 25 species of Polypodiaceae, 20 species of Dryopteridaceae and 16 species of Aspleniaceae were encountered. According to habitat types, the specimens can be classified into 4 groups: terrestrial plants (116 species), epiphytes (27 species), lithophytes (80 species), and aquatic plants (1 species). It was found that 2 species are new records for Thailand, i.e. *Huperzia carinata* (Desv. ex Poir.) Trevis. var. *laxum* (C. Presl) Christ and *Selaginella commutata* Alderw. Among the 205 taxa, 5 species, i.e. *Cephalomanes* sp., *Cyathea* sp., *Hymenophyllum* sp., *Nephrolepis* sp., and *Tectaria* sp. could not be determined due to the lack of fertile structures. There were nine other species apparently requiring further observations and investigation to determine their correct status, either as new species to science or new records for Thailand. These include two species each of the genera *Adiantum*, *Asplenium* and *Nephrolepis* and a species each of *Oleandra*, *Dryopteris* and *Vittaria*.

Wild orchid species and their distributions at Khao Nan National Park

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This study examined species diversity and abundance of wild orchids along five nature trails in Khao Nan National Park, Nakhon Si Thammarat. The five nature trails were Bua Chak Yai, Parah forest, Thaton-Yodnum, Sanyen, and Thaton-1400 m Peak. We found 26 genera of wild orchids with 36 species. When we separated wild orchids based on habitat types, we found that 18 species of wild orchids grew on trees, ten wild orchid species grew on soil, two wild orchid species grew on rocks, two wild orchid species grew on both trees and rocks and one wild orchid species grew on a limestone mountain. When we compared the number of wild orchid species and abundance among nature trails at Khao Nan National Park, we found the highest number of wild orchid species and highest abundance at Sanyen Nature trail. We found a total of 36 wild orchid species with a total of 552 wild orchid individuals.

The diversity of orchids at low altitude in Khao Nan National Park, Nakhon Si Thammarat Province, Thailand

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Field exploration and data collection of natural orchids was conducted at 60-600 m above mean sea level at Khao Nan National Park, during March 2006 to January 2007. A total of 167 specimens of orchids were collected from this focal site. All specimens were identified and kept in the Kasin Suvatabhandhu Herbarium, Department of Botany, Faculty of Science, Chulalongkorn University. They were classified into 5 subfamilies, 51 genera, and 103 species. There were 97 species of Epidendroideae, which was the most common subfamily. In the less common subfamilies, 3 species of Orchidoideae, 1 species of Apostasioideae, 1 species of Cypripidioideae and 1 species of Vanilloideae were found. The most common genus, *Dendrobium*, had the highest number of species among orchid genera, i.e. 24. According to habitat type, specimens could be classified into 3 groups: terrestrial orchids (13 species including 3 saprophytes), epiphytes (79 species), and lithophytes (5 species). Moreover, 6 species of orchids were found in more than one habitat. Two species were found to be newly recorded species for Thailand, i.e. *Dendrobium lobatu*m (Bl.) Miq. and *Oberonia semifimbriata* J.J.Sm. It is important to note that these newly recorded species were found only once and in rather small numbers. They could thus be considered as threatened species which, without good protection, might easily disappear from the area. There were 28 undetermined species; they apparently require further observations and investigation to determine their correct statuses. They were classified into the genera, *Dendrobium, Bulbophyllum, Ceratostylis, Coelogyne, Eria, Flickingeria, Thrixspermum, Aerides, Agrostophyllum, Kingidium, Liparis* and *Micropera.* The most difficult to determine species belonged to the genus *Dendrobium* (10 species).

Ecology and distribution of Zingiberaceae at Khao Nan National Park

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Research on the ecology, habitat and distribution of Zingiberaceae was conducted at seven park ranger stations in Khao Nan National Park during January to June 2007. Ecological data, i.e. abundance and distribution, were recorded every 3 months. Ninety-four individuals were found. One third of the gingers grew in an area that had 60% or more canopy cover. On the other hand, there were four species growing in full sunlight. All gingers increased in the number of leafy shoots in June due to an increase in the amount of rainfall. Ginger densities ranged from 1 to 46 leafy shoots/m^2. We found the areas covered with gingers ranged from 0.1 to 100 m^2 depending on their habit. *Zingiber newmanii* I. Theilade & J. Mood had the highest density and was found at Klong Kan station. Inflorescences of favorite edible gingers, i.e., *Etlingera fulgens* (Ridl.) C. K. Lim and *Curcuma longa* L., were difficult to find because villagers collected the inflorescences or rhizomes before we could find them. The natural resources conservation plan at Khao Nan National Park still has the problem that implementers do not know the critical number of ginger species in order to conserve them.

Zingiberaceae diversity in Khao Nan and Khao Luang National Parks

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Zingiberaceae diversity in Khao Nan and Khao Luang National Parks was investigated from September 2006 to April 2007. Twenty-six species in 10 genera of the family Zingiberaceae were collected from nine stations at the study sites, less than 30% of the gingers recorded for southern Thailand. The Tribe Alpinieae was the largest tribe with 5 genera and 14 species. The Tribe Zingibereae was second with 4 genera and 10 species. The Tribe Globbeae included only 2 species in the genus *Globba*. Most gingers in this study grow in Tropical Evergreen Rain Forest. Only one species, *Amomum aculeatum*, grows in Lower Montane Rain Forest and Cloud Forest at 450-1,000 m in altitude, and *Globba leucantha* is the only species that grows in Lower Montane Rain Forest. Most soils in the study site were composed of sand from sandy-rock erosion. Therefore, at least 20 species grow in sandy type soil (Sandy Clay, Sandy Loam and Sandy Clay Loam). There were fewer species and a lower abundance of gingers in the interior part of the forest where they were found to be sparsely distributed. The highest diversity of species occured at altitudes 90-300 m and decreased as altitude increased. At least 6 species of gingers observed in Khao Nan National Park can be found in the northern part of Khao Luang National Park, e.g., *Zingiber newmanii*, distributed around the Klong Klai Basin. At least 8 species are potential ornamental plants. A few species, in particular the seed of *Zingiber newmanii*, *Etlingera fulgens* and *Etlingera elatior*, may prove to be important resources for medicinal essential oils, and 7 species are edible.

Climate factors affecting parah (*Elateriospermum tapos*) phenology

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Leaf and flower phenology was studied in individuals of a canopy species, *Elateriospermum tapos* (Euphorbiaceae), at Khao Nan National Park. Parah trees had a mean ± SD DAB of 226.87 ± 91.68 cm, DBH of 138.00 ± 46.13 cm, and tree height of 31.03 ± 9.41 m. Bud burst occured from 13th February to 24th March with a bud burst duration of 40 days. The number of bud bursts was 2.25 ± 2.97 branches/day. The maximum bud burst/day occured on 1 March 2007 with a total of 17 branches. Flower burst occurred from 15th February to 30th March with a flower burst duration of 44 days. The number of flower bursts was 2.05 ± 2.81 branches/day. The maximum flower burst/day occurred on 8 March 2007 with a total of 12 branches. Parah forest during November 2006 to June 2007 had an average temperature of 24.0 ± 3.14 °C, average % relative humidity of 90.8 ± 10.61 %, and average daily rainfall of 42.10 ± 100.06 mm.

Species diversity of *Ficus* L. (Moraceae) in Khao Nan National Park, Nakhon Si Thammarat Province

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The species diversity of fig species in Khao Nan National Park was thoroughly studied with the aims to reveal native species richness and local utilization. Transect lines were set up in the park and its neighboring areas; the total line length stretching over more than 40 km. Eight surveys were conducted to collect data and specimens. Specific identification followed largely the monumental works of Berg (2003a, 2003b, 2003c, 2003d, 2004), Berg and Corner (2005), Corner (1965), King (1887, 1888) and Ridley (1924) and collected materials were also compared to labeled materials kept in many herbaria. Plant-utilization data were compiled by directly interviewing local people. From the results, as much as 50 *Ficus* species were found. They were divided into 6 subgenera: *Urostigma* with 19 species; *Pharmacosycea* with 4 species; *Sycomorus* with 11 species; *Synoecia* with 6 species; *Sycidium* with 6 species and *Ficus* with 4 species. Ten fig species were found to have beneficial roles to local natives as food, and two species were well-known for consumption, i.e., *Ficus fistulosa* Reinw. ex Blume and *Ficus obpyramidata* King. Information obtained from this study can be used as baseline data for the study of the flora of Thailand, and should be of prime interest to other scientists who wish to know more about the taxonomy of fig trees. Some can be developed as food and products for business.

Species, abundance, feeding location, and feeding time of frugivores on dye fig (*Ficus tinctoria* forst.f. subsp. *gibbosa* (Blume) Corner) at Khao Nan National Park

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This study examined species, abundance, feeding location, and feeding time of frugivores on dye figs at Khao Nan National Park. There were two groups of frugivores feeding on fig fruits: birds and mammals. We found 17 species of bird and 1 squirrel. Each bird species fed on fig fruits differently. The top three frugivorous birds were *Dicaeum melanoxanthu* 14 individuals, *D. trigonostig* 13 individuals, and *Plycnonotus blanfordi* 13 individuals. Frugivores fed mostly in the middle of the tree. We observed from 12.00-16.00 hr with a total of 4 hrs. We found that the frugivores fed on figs differently and mostly fed between 13.00-14.00 hr. There were differences between bird species feeding locations and interactions between bird species and feeding location.

Monitoring the status of some large beetles by light trap at Khao Nan National Park

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This study examined species diversity and abundance of large beetles at Khao Nan National Park. There were 6 species in the 3 families, Scarabaeidae, Carabidae and Lucanidae. The protected insect, *Prosopocoilus giraffe*, in the family Lucanidae was found in high abundance at 0.0136 individuals/spot sample. A new record for Thailand was the violin beetle, *Mormolyce castelnaudi*, which was found to visit our light trap at Khao Nan Headquarters in March 2007. However, we found the highest beetle species richness in March, with four species.

Diversity of butterfly fauna in Khao Nan National Park, Nakhon Si Thammarat Province

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A study on the biodiversity of the butterfly fauna in Khao Nan National Park, Nakhon Si Thammarat Province, was conducted in order to gain preliminary knowledge on the species diversity, local distributions, abundance statuses and some relevant ecological data up to the hilly regions, emphasizing the cloud forest sub-ecosystem, including those affected by selected survey lines of 1,000 m long and 10 m wide. Surveys were conducted between 8 a.m. to 5 p.m. and line trapping occurred at 6 points each along the same survey lines. Species identification was done by using keys for identifying butterfly species of the Malay Peninsula, in particular, and of Thailand, in general, together with comparison with labeled specimens deposited in many insect collections. A total of 304 species were found in 5 families: Papilionidae (31 species), Pieridae (25 species), Nymphalidae (120 species), Lycaenidae (76 species) and Hesperiidae (52 species). The majority are southern subspecies of the known Thai fauna. Rare and uncommon species that were found were *Atrophaneura sycoryx, Losaria neptunus, Idealynceus, Neorina lowii, Polyura hebe, Cganlriodes libana, Poritia karenina, Choaspes subcaudatus, Odina hieroglyphica* and *Odontoptilum pygela.* Three protected species that were found were *Troides helena, Troides amphrysus* and *Papilio palinurus.*

Diversity of Olethreutinae (Lepidoptera: Tortricidae) in Khao Nan National Park, Nakhon Si Thammarat Province

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This biodiversity study of the Olethreutinae (Lepidoptera: Tortricidae) was based on a survey of species in Khao Nan National Park, Nakhon Si Thammarat. Collections were made at various sites in evergreen forest. More than 470 specimens of Olethreutinae were collected with blacklight and mercury vapor light on 70 nights during May 2006-April 2007. The survey resulted in the collection of 174 morphotypes divided into 7 tribes, namely Microcorsini, Gatesclarkeanini, Bactrini, Olethreutini, Enarmoniini, Eucosmini, and Grapholitini. Of these, 27 species in 22 genera were identified and 3 species are new records for the park and for Thailand. The survey also included 60 morphotypes that could be identified to 25 genera, but not to species level and 97 morphotypes are unidentified. One olethreutine species will be published as a new species of the genus *Fibuloides* Kuznetsov, namely *Fibuloides khaonanensis*, in reference to the name of Khao Nan National Park.

Monitoring the status of macro-moths by light traps at Khao Nan National Park

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This study investigated species diversity of macro-moths, and their abundances at Khao Nan National Park by light traps from January to April 2007. We found 11 species of macro-moth in four families: Uraniidae, Saturniidae, Eupterotidae and Spingidae. One species of Thai Protected insect, *Actias maenas*, and the export-import prohibited insect, *Lyssa zampa*, were found. *Lyssa zampa* in the family Uraniidae had the highest abundance of 0.0136 individuals/spot sample. We found the highest macro-moth species richness in March, with nine species.

Ants at Khao Nan National Park, Nakhon Si Thammarat Province

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The diversity of ants was investigated by 5 sampling methods, Hand collection(HC), Honey bait (HB), Leaf litter sifting (LL), Pitfall traps (PT) and Winkler bags (WB), at 3 study sites (Bua Chak Yai, Sunantha trial and Pra forest) in Khao Nan National Park. At each study site, 3 permanent plots of 30X30 m were established, giving a total of 9 permanent plots. Ant sampling was conducted bimonthly during March 2005-March 2006. A total of 250 species belonging to 49 genera in 10 subfamilies, namely Formicinae, Myrmicinae, Ponerinae, Dolichoderinae, Cerapachyinae, Pseudomyrmecinae, Aenictinae, Amblyoponinae, Ectatomminae and Dorylinae, were collected. The subfamily Myrmicinae had the highest number of species. The dominant genera in this study were *Pheidole, Tetramorium, Pachycondyla, Polyrhachis* and *Camponotus*.

Species composition of canopy ants (Hymenoptera: Formicidae) in tropical rainforest at Khao Nan National Park, Nakhon Si Thammarat Province

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The species composition of canopy ants was investigated in tropical rainforest at Khao Nan National Park (KNNP), Nakhon Si Thammarat Province, Southern Thailand. The insecticide fogging method was applied to collect canopy ants, bimonthly during May 2006 to March 2007 at two study sites: evergreen forest and briefly deciduous forest (*Elateriospermum tapos* Blume). Each study site consisted of three permanent plots of 30m x 30m. A total of 36 trees was randomly selected. The results showed 7 subfamilies, 37 genera and 213 morphospecies identified from 16,585 individuals. The Subfamily Myrmicinae (87 species) was the most dominant group followed by Formicinae (86 species), Dolichoderinae (25 species), Pseudomyrmicinae (6 species), Ponerinae (5 species), Anictinae (2 species), and Cerapachyinae (2 species). The top four genera were *Crematogaster* (39 species), *Camponotus* (39 species), *Polyrhachis* (37 species) and *Pheidole* (13 species). The canopy dwelling species with the greatest abundances of individuals were *Dolichoderus thoracicus* Smith (3123), followed by *Oecophylla smaragdina* Fabricius (1806), *Dolichoderus* sp.4 (1098), *Dolichoderus* sp.5 (1065), and *Crematogaster (Paracrema)* sp.2 (1019).

Diversity of terrestrial ant communities at Khao Nan National Park, Nakhon Si Thammarat Province

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A study on the diversity of terrestrial ant communities at two study sites (Pra Forest and the Headquarters of Khao Nan National Park) at Khao Nan National Park was carried out bimonthly during January 2006 to January 2007. Five sampling methods were applied to collect ants: a hand collecting method (HC), leaf litter sifting (LS), Winkler extraction samples or Winkler's bags (WB), honey baits (HB) and pitfall traps (PT). Ten subfamilies, 50 genera and 235 species were identified. Myrmicinae, Formicinae and Ponrinae were dominant at the subfamily level. Large numbers of species were found in the genera *Pheidole*, *Camponotus*, *Pachycondyla* and *Tetramorium*. In this study, it was also shown that *Camponotus festinus*, *Camponotus rufifermus*, *Echinopla* sp. 2, and *Gnamptogenys menadensis* were dominant species in Pra forest while *Anoplolepis* sp.1, *Pheidole* sp. 12 and *Tetramorium cutalum* were dominant at the Headquarters of Khao Nan National Park.

Habitat characteristics and feeding behavior of the Sumatran tiger barb at Nhanchongfa Waterfall, Khao Nan National Park, Nakhon Si Thammarat Province

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This study aims at studying the habitat characteristics and feeding behavior of the Sumatran tiger barb (*Puntius partipentazona* (Fowler, 1934)) at Nhanchongfa Waterfall, Khao Nan National Park, Thailand. There were 42 Sumatran tiger barbs collected with 20 males and 22 females. Males were 4.00 cm in standard length, 4.69 cm in total length and 1.93g in total body weight. Females were 4.11 cm in standard length, 5.09 cm in total length and 2.35 g in total body weight. The Sumatran tiger barb is a small-sized fish with a compressed form, terminal mouth, villiform teeth, cycoid scales, and a forked tail. Body colour was yellow interrupted by four wide black stripes, the bottom portion of the dorsal fin was black, the upper portion of the dorsal trimmed was red, the upper and lower lobes of the tail and ventral fins were red, and the snout was red. The bladder had a J-shape and inside the bladder was found small insects. The body length to bowel length ratio was 2:1. The water temperature ranged from 28 – 29 C°. Acid - alkalinity ranged from 6.90 – 7.36 mg/l. Dissolved oxygen ranged from 4.31 – 4.34 mg/l.

Discrimination of *Tor tambroides* populations at waterfalls at Khao Nan National Park, Nakhon Si Thammarat Province

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We classified the number of *Tor tambroides* populations at three waterfalls (i.e. Sunanta, Nan Chong Fa and Wang Muang waterfalls) at Khao Nan National Park, Nakhon Si Thammarat Province, by using multivariate analysis and stepwise discriminant analysis. A total of 116 specimens of *Tor tambroides* was collected during July-August 2006 from three waterfalls. Each individual was measured using seven morphometric variables and 21 Truss variables. Multivariate analysis and stepwise discriminant analysis showed significant differences among the three waterfall populations.

Amphibians and reptiles of Khao Nan National Park, Nakhon Si Thammarat Province: species list, with natural history notes, and discussion of the diversity at the Upper Khao Luang Range

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A herpetofauna survey was carried out in Khao Nan National Park, northern Nakhon Si Thammarat, Thailand, between April 2006 and May 2007, and documented 67 species of reptiles and 31 species of amphibians. Records of interesting species for this area include *Ansonia* sp., *Ingerana* sp., *Limnonectes* sp., *Larutia* sp., *Ramphotyhlops* sp. and *Pareas* sp. We herewith provide notes on the natural histories of some amphibians and reptiles in this study.

Installing tags along nature trails at Khao Nan National Park, Nakhon Si Thammarat

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This study involved tag installation along five nature trails at Khao Nan National Park, Nakhon Si Thammarat. These five nature trails comprised (1) Klongkai-Sanyen with a total distance of 34 km, (2) Hui Lek- Parah forest with a total distance of 12 km, (3) Buachek-Sunanta Peak with a total distance of 13 km, (4) Thaton-Yodnum with a total distance of 20 km and (5) Thaton-1400 m Peak with a total distance of 32 km. Once we installed all tags along each nature trail, we sent these data to the NBIDS-BRT database. This kind of information will be useful for park rangers, tourists, and researchers. Most of the time, researchers have some problem with finding coordinates or elevations of their study sites due to some GPS units not being able to be used in dense vegetation, especially in dense tropical rainforest canopy.

Assessing habitat-suitability models with a virtual species at Khao Nan National Park, Thailand

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This study investigated the use of a habitat-suitability assessment method, namely Ecological Niche Factor Analysis (ENFA). A virtual species was created and then dispatched in a geographic information system model of a real landscape in three historic scenarios: (1) spreading, (2) equilibrium, and (3) overabundance. In each scenario, the virtual species was sampled and these simulated data sets were used as inputs for the ENFA to reconstruct the habitat suitability model. The 'equilibrium' scenario gives the highest quantity and quality among the three scenarios. ENFA was sensitive to the distribution scenarios but not sensitive to sample sizes. The use of a virtual species proved to be a very efficient method, allowing one to fully control the quality of the input data as well as to accurately evaluate the predictive power of the analyses.

Network of Biodiversity Database System (NBIDS-BRT)

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A Network of Biodiversity Database System (NBIDS-BRT) has been developed for collecting Thai biodiversity data. The NBIDS-BRT aims at providing advanced tools for querying, analysing, modelling, and visualising patterns of species distribution for biologists. We can enter data using a web-service, search information, visualise data using web*Mathematica* and show locations of study sites on Google™ Earth map. NBIDS-BRT has been online at URL http://www.nbids.org since November 2005. Now NBIDS-BRT includes three initiative projects (i.e. Khao Nan Cloud Forest, Western Thong Pha Phum, and Khanom Marine Biodiversity Initiative Projects), 54 sub-projects, 20,348 biodiversity data records, 2,883 species records including 4 new species, 110 new records for Thailand, 2 rare species, 11 endemic species, 11 dominant species, 10 new locality records, 2 newly recorded genera, 6 threatened species, 2,731 environmental data records and 2,102 field study sites.

A general survey of marine filamentous fungi at Had Khanom-Mu Koh Thale Tai National Park, Nakhon Si Thammarat

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Three collecting trips were made to four collecting sites at Had Khanom–Mu Koh Thale Tai National Park (October 2006, February 2007, May 2007). Approximately 1,300 substrata were collected, including mangrove woods, fruit, prop roots, sea grasses and sea weeds. One hundred and six fungal collections were enumerated yielding 84 ascomycetes (79.2%), 20 anamorphic fungi (18.9%) and 2 basidiomycetes (1.9%). Forty taxa were identified to species level, 44 taxa were identified to genera level and 22 taxa await further identification. On the basis of species diversity, site 3 (western area of Tan island) showed the greatest percentage of occurrences at 19.5%, while site 1 (Khanom mangrove study center), site 2 (Khanom canal) and site 4 (sandy beach, eastern area of Tan island,) gave lower percentages at 10.8, 9.7 and 6.6%, respectively. Moreover, we found *Lindra thallasiae* and *Varicosporina prolifica* on sea grasses, and *Swampomyces aegyptiacus* on wood was noted as a new record for Thailand. A total of 120 isolates have been deposited in the BIOTEC Culture Collection (BCC). Data is continued being gathered for this project. Comparisons of fungi occurring at different collecting sites at different collecting times, percentage abundances, percentage colonizations, are in progress.

Diversity, distribution, abundance and monitoring of seaweeds at Koh Taen, Had Khanom-Mu Koh Thale Tai National Park, Nakhon Si Thammarat Province, Thailand

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The diversity, distribution, abundance and monitoring of seaweeds at Koh Taen, Had Khanom-Mu Koh Thale Tai National Park, Nakhon Si Thammarat Province, Thailand, were investigated in both May and July 2006. Four study sites were chosen and permanent plots were established in high species-rich areas around the island. Applying a "line transect method" and quadrats, the percentage cover of macroalgae was assessed. A total of 18 species were identified during this study, comprising 1 species of Cyanophyta, 6 of Chlorophyta, 4 of Phaeophyta and 7 of Rhodophyta. The brown algae, *Sargassum* spp. and *Turbinaria* spp., were the most common. As a result of this study we found that seaweed diversity has decreased from 41 species identified in October 2005 to 18 species during this study. For example, *Boodlea composita* (Harvey) F. Brand was the dominant species in site 3 in 2005 but was absent from all sites during this study.

The plankton community in relation to environmental factors along Khanom canal, Khanom beach, Mu Koh Thale-Tai, Nakhon Si Thammarat

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A total of 71 phytoplankton genera in 3 Divisions were investigated from quantitatively collected samples in October 2006, January 2007 and March 2007. The most diverse Division was Chromophyta, comprising the Class Bacillariophyceae with 38 genera, Class Dinophyceae with 19 genera and Class Dictyochophyceae with 1 genus. *Navicula*, *Nitzchia* and *Oscillatoria* were the most frequently found genera throughout all sampling periods. However, based on density, *Chaetoceros* spp. dominated phytoplankton at all stations sampled throughout the sampling periods. Zooplankton samples were identified into 50 genera in 11 Phylum. Arthropoda was the most diverse phylum comprising 24 genera, of which nineteen were members of the Class Copepoda. The nauplii of crustaceans were dominant at all marine stations throughout all sampling periods, and included the genera *Codonellopsis* and *Tintinnopsis*. Environmental factors along Khanom canal, Khanom beach and around the islands during the months of sampling were not much different among marine stations, although nitrate usually showed higher amounts than other nutrients. However, continuous records of plankton diversity and water quality in an annual cycle are necessary to explain the relationships between plankton communities and environmental factors in this area.

Diversity, distribution and abundance of seagrasses at Khanom-Mu Koh Thale Tai National Park, Nakhon Si Thammarat Province, Thailand

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The diversity and abundance of seagrasses were studied at Koh Ta Rai, Khanom-Mu Koh Thalae Tai Marine National Park, Nakhon Si Thammarat, Thailand. The study was carried out at 2 study sites. A total of six permanent transect lines were investigated. The first data collection was already conducted in July 2006 and the results indicated that 4 species of seagrasses were found, i.e., *Thalassia hemprichii* (Ehrenb.) Aschers, *Halodule uninervis* (Forsskål) Aschers, *Cymodocea rotundata* Ehrenb. Et Hempr. Ex Aschers and *Enhalus acoroides* (L.f.) Royle.

Species diversity of marine sponges inhabiting coral reefs in Had Khanom – Mu Koh Thale Tai National Park, Nakhon Si Thammarat Province, Thailand

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The species diversity and distributions of demosponges inhabiting coral reefs in Had Khanom – Mu Koh Thale Tai National Park, in the southern Gulf of Thailand, were investigated by field surveys undertaken at 12 sites in November 2006 using SCUBA and random observations. Forty-five species of demosponges from 10 orders, 24 families and 34 genera were recorded. The most abundant and common sponges in this area are *Oceanapia sagittaria*, *Neopetrosia* sp. "blue", *Xestospongia testudinaria*, and *Haliclona (Gellius) cymaeformis*. Most species are common representatives of the Indo-Pacific fauna found throughout the Gulf of Thailand.

Water circulation and suspended sediment dispersion around Khanom Beach, Southern Sea Island

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The purpose of this project is to study the circulation and dispersion of suspended sediment particles at Khanom Beach, Southern Sea Island. The main hypothesis is that the circulation and dispersion of sediment control distribution of the coral. Two field samplings will be carried out, and a numerical circulation and dispersion model will be applied to the dispersion of sediment or coral eggs in the area. The project will be completed in 2 years (Jan 2007 – Dec 2008).

Coral biodiversity at Khanom - Mu Koh Tale Tai Marine National Park

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Coral biodiversity was studied at Khanom - Mu Koh Tale Tai Marine National Park. We went snorkeling and took coral photographs underwater. We compared two sampling techniques. The first random photograph technique did not have a scale reference. The second random photograph technique used a quadrat, 50 x 50 cm^2, for a scale reference. The image data were classified and analyzed to calculate biodiversity indices such as the Shannon-Wiener index and the Simpson index. Values of the Shannon-Wiener index were for Koh Tan, 1.73 and 1.57, Koh Mud Soom, 1.63 and 1.59, and Ao Tong Yee, 1.61 and 1.57, for the no scale reference technique and the quadrat reference technique, respectively. Values of the Simpson index were for Koh Tan, 0.86 and 0.80, Koh Mud Soom, 0.91 and 0.89, and Ao Tong Yee, 0.85 and 0.81, for the no scale reference technique and the quadrat reference technique, respectively. This investigation revealed a high coral biodiversity at Khanom - Mu Koh Tale Tai Marine National Park.

Species diversity and distribution of gorgonians at Had Khanom – Mu Koh Thale Tai National Park, Nakhon Si Thammarat

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Gorgonians are marine invertebrates that belong to the phylum Cnidaria, as do corals and jelly fish. Gorgonians are classified into the same group (subclass Octocorallia) as blue corals, soft corals and sea pens. Unlike corals and sea anemones, which have 6 tentacles, gorgonians have 8 tentacles, which are used for catching food. The purpose of this study was to investigate the diversity and distribution of gorgonians at Had Khanom - Mu Koh Thale Tai National Park by using the SCUBA diving technique. Samples were photographed and some were collected and preserved in 70% alcohol for further identification and for being reference specimens. Shapes and characteristics of colonies and sclerites of gorgonians were used to identify to genus level. Results from the first survey at Koh Tan showed that there were 10 identified genera of gorgonians while 4 specimens are still unknown. They were found at 5-12 m depth of water and were normally attached to rocks, dead corals, or rubble that lay beneath sand or silt substrates. Their distribution was clumped. The dominant genus was *Subergorgia*. More surveys will be conducted.

Pseudo-imposex in some female volutes (Gastropoda: Volutidae)

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The occurrence of a penis in female gastropods has commonly been accepted as an indicator of tributyltin (TBT) pollution. It mainly occurs in females of the superfamily Muricoidea (infraorder Neogastropoda). Some species seem less sensitive than others, and one belonging to the Columbellidae has been reported to lack the imposex response. During a survey in S.E. Asian waters, we initially considered female volutes with small penises and an external vas deferens as showing imposex. Doubt arose, however, when 100% of the females had a penis at sites where other gastropods showed no or low imposex incidence. During the present study, hypotheses, such as volutes being extremely sensitive to TBT, or old volutes having a greater chance of coming into contact with TBT than young volutes, or volutes changing sex during growth, were rejected. This forced us to search for museum specimens collected before 1960, which is long before TBT was brought into use as a poison in anti-fouling paint. In the Australian Museum in Sydney and the Zoological Museum in Amsterdam some species were found from Indonesian and Australian waters. All inspected females showed the typical small penis and vas deferens and so it became clear that this is a natural phenomenon in these species, which is unknown in other gastropod species. We consider these male characteristics not to be induced by TBT pseudo-imposex, and have been found in *Cymbiola nobilis, C. vespertilio, Melo amphora, M. melo* and *M. umbilicata*. These species belong to the Volutidae subfamily Cymbiinae. However, pseudo-imposex is missing in species belonging to the subfamilies Odontocymbiolinae and Zidoninae from South America; they show a normal TBT induced imposex response according to recent literature.

Species diversity of nudibranchs at Had Khanom – Mu Koh Thale Tai National Park, Nakhon Si Thammarat

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The purpose of this study was to investigate the diversity and habitat ecology of nudibranchs at Had Khanom - Mu Koh Thale Tai National Park. Nudibranchs belong to the mollusk group (subclass Opisthobranchia), but have no shell protecting the soft body. Specimens were collected by using the SCUBA diving technique. Then, specimens were photographed and recorded by using VDO camera before they were preserved in alcohol. Shapes, body colors, and color patterns of nudibranchs were used to identify to species level. The results showed that nudibranchs can be found on coral colonies, coral reefs, and sand substrates between 1-15 m depth of water. At least 11 species of nudibranchs were found at Had Khanom - Mu Koh Thale Tai National Park. The species included *Phyllidia* cf. *elegans, Phyllidiella nigra*, *Phyllidia coelestis, Chromodoris preciosa, Flabellina rubrolineata*, *Glossodoris atromarginata*, *Jorunna funebris, Glossodoris cincta, Dendrodoris* sp., *Bornella* sp., and *Phyllodesmium magnum.* The dominant nudibranch species were in the Family Phyllidiidae. More surveys will be conducted.

Diversity study of Echinoderms of Khanom Beach, South Sea Islands National Park, Nakhon Si Thammarat Province

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Echinoderms of Had Khanom – Mu Koh Thale Tai National Park, Nakhon Si Thammarat Province, located in the southern part of the Gulf of Thailand were studied at 12 sites, namely Koh Tan (4 sties), Koh Mudsum (2 sites), Koh Wang Nai (2 sites), Koh Wang Nok (2 sites) and Koh Rab (2 sites) in November, 2006. The investigations were carried out by SCUBA diving in the daytime and random searches throughout the reefs. The results yielded 13 species of Echinoderms from 4 classes, 5 orders, 8 families and 10 genera. The most abundant Echinoderms in this area are: *Lamprometra palmate, Ophiothrix exigua, Holothuria (Metensiothuria) leucospilota*, and *Diadema setosum*. All observed species are commonly found in the Gulf of Thailand and the Indo-Pacific.

Species diversity of marine Ascidians dwelling in coral reefs of the Khanom-South Islands, Nakhon Si Thammarat Province

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The species diversity and distribution of ascidians dwelling in coral reefs in Had Khanom – Mu Koh Thale Tai National Park, Nakhon Si Thammarat Provice, in the southern Gulf of Thailand were investigated. The investigations were conducted at 12 sites in the Mu Koh Thale Tai area in November 2006. The investigations were carried out by SCUBA diving during the daytime and random observations throughout the reefs. The results yielded 10 species of ascidians from 3 orders, 3 families and 5 genera.

Status of dolphins in Had Khanom -Thale Tai Archipelago, Thailand

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The status of dolphins was surveyed in Had Khanom-Thale Tai Archipelago, Thailand, from Koh Tarai to Thong-yang bay and covering Koh Tan, Koh Rab, Koh Vangnai, Koh Vangnok and Koh Madsum, during August 2006 to July 2007. Interviews of 43 persons, comprising fishermen and tourists, in Amphur Khanom, Nakhon Si Thammarat, were conducted. It was determined that 100% of fishermen and tourists saw three types of dolphins, namely *Sousa chinensis*, *Orcaella brevirostris* and *Neophocaena phocaenoides*. A ship-based survey of 17 trips resulted in two species of the Family Delphinidae being found. For the first species, the Indo-Pacific hump backed dolphin *(Sousa chinensis)*, about 17 individuals were found. It seemed to be a native species because it was found every trip, and was distributed along Thongshing bay, Koh Tharai, Koh Vang nai, Prathup cave, Taled bay, Kokao beach, Kwang Phao bay. For the second species, the Irrawaddy dolphin *(Orcaella brevirostris)*, about 5-7 individuals were found, which were distributed along Thong Por bay, Tong Ta Khum bay and Taled bay. Behavior was studied. Data on stranding of dolphins during 2004-2007 showed 3 species among 10 stranded dolphins. Six Indo-Pacific hump backed dolphins *(Sousa chinensis)* were stranded at Thongnian bay and Niphao beach. One stranded Irrawaddy dolphin *(Orcaella brevirostris)* was found at Thongnian bay. Three Finless porpoises *(Neophocaena phocaenoides)* were stranded at Khanom golden beach hotel and Niphao beach. Most strandings were caused by fishing gear and for some the causes were unknown. The statuses of dolphins in Had Khanom-Thale Tai Archipelago are those of critically endangered species.

Diversity of macroalgae and benthic diatoms in the area of the Golden Jubilee Thong Pha Phum Project, Thong Pha Phum District, Kanchanaburi Province, Thailand

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A study on the diversity of macroalgae and benthic distoms in the area of Thong Pha Phum Project, Thong Pha Phum District, Kanchanaburi Province was carried out from November 2001 – January 2003. Samples were collected from 7 sites which covered the project area. Sixty-one species of macroalgae were found and classified into 4 divisions. The majority of them were green algae e.g. *Zygnema* spp., *Spirogyra* spp. and *Stigeoclonium* spp. in Division Chlorophyta; red algae e.g. *Batrachospermum* spp. and *Audouinella* spp. in Division Rhodophyta; and blue green algae e.g. *Nostochopsis lobatus* Wood and *Phormidium* spp. in Division Cyanophyta. One hundred and sixty two species of benthic diatoms were found and classified in Division Bacillariophyta. Most of them were pennate diatoms e.g. *Achnanthes* spp., *Frustulia* spp., *Navicula* spp. and *Gomphonema* spp. Fifty-six species were new records for Thailand, of which eleven species were macroalgae and forty-five species were benthic diatoms. Some physical and chemical factors were investigated for evaluating water quality. It was found that the water quality based on trophic level in the undisturbed area could be classified into oligotrophic-mesotrophic status. In the disturbed area, the water quality was in mesotrophic - eutrophic status.

Bryophyte diversity at Thong Pha Phum National Park, Kanchanaburi Province

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Surveys and collections of bryophyte specimens in Thong Pha Phum National Park were carried out from July 2004 to October 2005 from 4 sites: 1) hill evergreen forest 2) disturbed areas from mining around E-Tong village, 3) hot springs and the surrounding areas, 4) freshwater springs. A total of 400 specimens was collected. They were determined into 117 species within 80 genera and 40 families. There were 69 species of mosses, 45 species of liverworts (4 species of thalloid liverworts and 41 species of leafy liverworts) and 3 species of hornworts. It was found that hill evergreen forest had the highest number of species, freshwater springs was second, and hot springs and the surrounding areas had the lowest number of species. Nine species of bryophytes namely *Aneura pinguis* (L.) Dumort., *Asterella khasyana* (Griff.) Pandé et al., *Cyathodium cavernarum* Kunze, *Dicranolejeunea javanica* Steph., *Fissidens flaccidus* Mitt., *Folioceros udarii* A.K. Asthana & S.C.Srivast., *Notothylas javanicus* (Sande Lac.) Gottsche, *Schiffneriolejeunea tumida* (Nees) Gradst. var. *tumida*, and *Weissia controversa* Harv. are new records. Furthermore, *Dicranolejeunea* (Spruce) Schiffn. is a newly recorded genus for Thailand.

Pteridophyte flora of Thong Pha Phum National Park, Kanchanaburi Province

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A total of 26 families, 69 genera, and 171 species were recorded from Thong Pha Phum National Park, Kanchanaburi Province. Among these, 23 families, 65 genera, and 155 species were ferns, while 3 families, 4 genera and 16 species were fern allies. Among the fern allies, Selaginellaceae had the highest number of species, i.e. 12. Three families of ferns, namely Polypodiaceae, Thelypteridaceae, and Dryopteridaceae were among the common families. Polypodiaceae included 37 species, while Thelypteridaceae and Dryopteridaceae included 25 and 16 species, respectively. According to habitat, it was found that there were 96 species of terrestrial plants, 57 species of epiphytes, 23 species of lithophytes and 2 species of aquatic plants. In addition, 6 species of ferns and fern allies were found in more than one habitat. It was found that 5 species and 1 variety are new records for Thailand, i.e. *Adiantum philippense* L. var. *subjunonicum* H. Christ, *Arachniodes coniifolia* (Moore) Ching, *Belvisia spicata* (L.f.) Mirbel ex Copel., *Loxogramme centicola* M.G. Price, *Polystichum pseudotsus-simense* Ching and *Polystichum scariosum* (Roxb.) C. Morton. It is important to note that three new records, namely *Arachniodes coniifolia*, *Polysticum pseudotsus-simense*, and *Polysticum scariosum* are found only once and in rather small numbers. These species may be extirpated from the country soon if their present habitats continue to be disturbed. Among the 175 taxa, 9 species can not be determined due to the lack of fertile structures as well as of keys to species. It seems likely that 3 out of the 9 unknown species are probably newly recorded taxa for Thailand or new to science, viz. 1 species of *Cyathea* and 2 species of *Pteris* and are worth further investigating.

Pteridophyte diversity along a gradient of disturbance within mines in Thong Pha Phum District, Kanchanaburi Province

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The diversity of pteridophyte in Thong Pha Phum District, Kanchanaburi Province was conducted along a gradient of disturbance within mines, from July 2002 to March 2003. Twelve plots of 5 x 20 meters have been established in each three study sites, i.e. abandoned mines, remnants of the forest in mine area and natural forests. Species richness, species diversity and species evenness indices were estimated using Menhinick's, Shannon-Weiner's and evenness indices, respectively. Species similarity was investigated using Jaccard's coefficient. Other physical environments related to pteridophyte diversity were examined, including light intensity and leaf temperature. It was found that species richness and species diversity of abandoned mines were lower than those of remnants of the forest in mine area and natural forests, while species evenness was the highest of all. Low Jaccard's coefficient was observed, indicating the difference of species composition between each sites. Light intensity and leaf temperature showed negative significant correlation with Menhinick's index, but was positively significantly correlated with evenness index. One hundred and eighty-four specimens of pteridophytes were collected from the 36 sampling plots and were identified to 65 species, 1 subspecies, 5 varieties, in 40 genera, within 20 families. Among these 8 species, 2 genera, 2 families are fern allies. It was found that *Cheilanthes tenuifolia* (Burm. f.) Sw., *Sphenomeris chinensis* (L.) Maxon var. *divaricata* (H. Christ) K.U. Kramer and *Lycopodiella cernua* (L.) Pic. Serm. were found only in abandoned mines and tend to be indicator species for disturbed areas. Two terrestrial ferns, namely *Lindsaea ensifolia* Sw. and *Pteris biaurita* L. were commonly found in all study sites.

Diversity of ferns and fern allies in natural forest and along the natural gas pipeline in Thong Pha Phum District, Kanchanaburi Province

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The diversity of ferns and fern allies has been assessed along the natural gas pipeline in Thong Pha Phum District, Kanchanaburi Province from October 2001 to August 2002. A total of twenty-four sampling plots of 20 m X 20 m (4, 5 X 20 m subplots inside) have been established from KP 0 to KP 33. The diversity of ferns and fern allies in disturbed (along gas pipeline) and undisturbed (natural forest) areas was determined by counting the individuals in each subplot. Species richness and species diversity were estimated using Margalef and Shannon-Weiner diversity indices, respectively. Species similarity was also investigated using Jaccard's coefficient. Other physical factors related to pteridophyte diversity were examined. Species richness and species diversity of natural forests were higher than those along the natural gas pipeline with the only exceptions being at KP 6 and KP 9. Low or nil values of Jaccard's coefficient was observed indicating different species of pteridophytes in natural forests compared with those found along the gas pipeline. Margalef and Shannon diversity indices were positive and significantly correlated with %soil water content, but a negative significant correlation was observed with light intensity (%PAR). Canonical discriminant analysis was employed to reveal differences of physical environmental factors between the disturbed and undisturbed areas. It was found that soil pH and light intensity (%PAR) were the two most important factors in this regard. Ninety pteridophyte specimens were collected from the 24 sampling plots. They were identified and classified into 46 species, in 31 genera within 17 families. Of these, 3 species, 3 genera and 2 families are fern allies.

Family Annonaceae in Thong Pha Phum National Park, Kanchanaburi Province

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There were 40 species in 18 genera of Annonaceae collected from the Western Forest Complex of Thailand. Among them, 12 annonaceous species were found at Thong Pha Phum National Park: *Anaxagorea javanica* Blume, *Anomianthus dulcis* (Dunal) J. Sinclair, *Artabotrys siamensis* Miq., *Cananga odorata* Bail. ex King var. *fruticosa*, *Goniothalamus griffithii* Hook.f.& Thoms., *Meiogyne virgata* Miq., *Miliusa longiflora* (Hook.f.&Thomson) Baillon ex Finet & Gagnep., *Miliusa velutina* (Dunal) Hook.f. & Thoms., *Mitrephora maingayi* Hook. f. & Thoms., *Orophea brandisii* Hook.f. & Thoms., *Polyalthia viridis* Craib, and *Polyalthia kanchanaburiana* S. Khumchompoo & A. Thongpukdee. One new record for Thailand, *Miliusa longiflora* (Hook. f. & Thomson) Baillon ex. Finet & Gagnep, and one new species, *Polyalthia kanchanaburiana* S. Khumchompoo & A. Thongpukdee, were determined. A large number of species of Annonaceae may be possibly distributed in the complex.

Systematic studies of the Leguminosae - Caesalpinioideae in Thong Pha Phum Forest, Kanchanaburi Province

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Systematic study of the Leguminosae-Caesalpinioideae in Thong Pha Phum Forest, Kanchanaburi Province are focused on morphological characters, ecology, distribution, diversity of species and habitats and to produce taxonomic keys. This study was conducted by surveying and collecting plants from various vegetation types in Thong Pha Phum Forest. Photographs including morphological and ecological data were recorded for each plant species. Specimens were identified using morphological characters and compared with identified specimens deposited at the Forest Herbarium, National parks, Wildlife and Plant Conservation Department, and the Siridhorn Herbarium, Department of Agriculture. Keys to genera and species with full descriptions supported by line drawings were provided. After surveying in the area for a period of twelve months, plant specimens comprising 12 genera and 31 species were found as follows: *Afzelia* (1 species), *Bauhinia* (11 species), *Caesalpinia* (5 species), *Cassia* (1 species), *Chaemaecrista* (1 species), *Cynometra* (1 species), *Gymnocladus* (1 species), *Peltophorum* (1 species), *Pterolobium* (1 species), *Saraca* (1 species), *Senna* (6 species), and *Sindora* (1 species). A species recognized as a new record was *Cynometra beddomei* Prain. *Bauhinia glauca* subsp. *tenuiflora* (Watt. ex C.B. Clarke) K. & S.S. Larsen, *B. nervosa* (Wall. ex Benth) Baker, *Caesalpinia andamandica* (Prain) Hattink, *Pterolobium integrum* Craib, and *Saraca cauliflora* Baker are new locality records.

Systematic studies of Rubiaceae in Thong Pha Phum Forest, Kanchanaburi Province, Thailand

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Systematic studies of Rubiaceae in Thong Pha Phum Forest, Kanchanaburi Province, were conducted by surveying and collecting specimens from May 2003 to April 2005. This study focused on morphological characters, ecology and distribution. One hundred and five specimens were collected. Based on examining plant specimens, 43 species, 2 subspecies and 2 varieties of 28 genera were found consisting of 17 species of herbaceous plants, 7 genera (7 species) of trees, 11 genera (16 species, 2 subspecies) of shrubs and 4 genera (3 species, 2 varieties) of climbers. *Morinda* specimens were both shrubs and climbers, whilst *Wendlandia* were both trees and shrubs. This group was distinguished by the presence and absence of thorns and hooks. There were 5 genera (4 species and 2 varieties) of plants with thorns and hooks, and 15 genera (22 species and 2 subspecies) without thorns and hooks. 10 species and 2 varieties are recognized to be new locality records in this study.

Taxonomic study of grasses (Family Gramineae) in Western Thong Pha Phum, Thong Pha Phum District, Kanchanaburi Province

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A taxonomic study of grasses (Family Gramineae) in Western Thong Pha Phum, Thong Pha Phum District, Kanchanaburi Province, was conducted. As a first step, data on grasses were compiled from both literature and herbarium specimens kept in the Forest Herbarium, National Parks, Wildlife and Plant Conservation Department (BKF) and Bangkok Herbarium of the Department of Agriculture (BK). Then additional field surveys and plant collections in Western Thong Pha Phum were conducted. Morphological and ecological data of plants were recorded and photographs were taken. All plant specimens were identified by consulting literature and comparing with specimens named in both herbaria. Nomenclatural problems were solved. From the study of grasses found in Western Thong Pha Phum, keys for 5 subfamilies, 40 genera and 66 species were constructed. Full descriptions and ecologies of species, supported by line drawings and photographs of grasses were provided. In this study *Paspalum canarae* (Steud.) Veldkamp var. *fimbriatum* (Bor) Veldkamp was recognized as a new record for Thailand.

Taxonomic studies of bamboo (Poaceae): genus *Bambusa* Schreber, *Dendrocalamus* Nees and *Gigantochloa* Kurz in Western Forest Complex

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Taxonomic studies of three genera of bamboo (Bambusoideae: Poaceae) in the Western Forest Complex have been carried out. Classical herbarium techniques were used in this project. A key to species and species descriptions will be provided. 11 bamboo species are reported. Three species of *Bambusa* Schreber are *B. bambos* (L.) Voss, *B. tulda* Roxb. and *B. vulgaris* Schrad. ex H. Wendl. However, *B. vulgaris* Schrad. ex H. Wendl. is not a native species of this study area. It has been introduced as an ornamental plant. Five species of *Dendrocalamus* Nees are *D. brandisii* (Munro) Kurz, *D. copelandii* (Gamble ex Brandis) N.H. Xia & C.M.A. Stapleton, *D. membranaceus* Munro, *D. strictus* (Roxb.) Nees and *Dendrocalamus* sp.1. Three species of *Gigantochloa* Kurz are reported, namely *G. albociliata* (Munro) Munro, *G. auriculata* Kurz, and *G. macrostachya* Kurz. Two of these species are newly recorded for Thailand as follows: *D. copelandii* (Gamble ex Brandis) N.H. Xia & C.M.A. Stapleton, which occured on limestone mountains, and *G. macrostachya* Kurz. in Tak province.

Systematic studies of Zingiberaceae in Thong Pha Phum Forest, Kanchanaburi Province

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Systematic studies of the Zingiberaceae were conducted from May 2003 to May 2005, in order to enumerate species diversity, characteristics, habits, ecological habitats and uses. A databaseresulting from this research will be used for management and maintenance of biological resources. Surveying and collecting specimens in several plant communities from 200-950 m altitude were undertaken. All collected specimens were identified by comparing with the specimens deposited at the Sirindhorn Herbarium of the Department of Agriculture (BK) and the Bangkok Forest Herbarium of the Royal Forest Department (BKF). Keys to genera and species were constructed. Genus and species descriptions were also provided. Fertile specimens were examined and identified, with 10 genera and 36 species found as follows: *Alpinia*, *Amomum*, *Boesenbergia*, *Curcuma*, *Elettariopsis*, *Etlingera*, *Globba*, *Hedychium*, *Kaempferia* and *Zingiber*. The genera most commonly found were *Curcuma* (7 species), *Globba* (6 species), *Boesenbergia* (6 species), *Zingiber* (5 pecies) and *Kaempferia* (4 species). A species recognized as an endemic species was found, namely *Boesenbergia siamensis* (Gagnep.) P. Sirirugsa. *Alpinia galanga* var. *pyramidata* (Blume) K. Schumann, *Amomum koenigii* J.F. Gmelin, *Curcuma oligantha* Trimen, *Globba macrocarpa* Gagnep., *G. schomburgkii* var. *schomburgkii* and *Zingiber newmanii* I. Theilade & J. Mood are new locality records.

Diversity of vascular plants at springs in Moo Ban Tha Ma Dua, Thong Pha Phum District, Kanchanaburi Province

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Springs in Moo Ban Tha Ma Dua are a unique habitat to which water is supplied from underground streams that spring up above ground nearly all year round. The vegetation is still in prime condition and no botanical inventory has yet been made. Thus, the present study has the objective to investigate vascular plants in this area. A survey and collection of vascular plants was carried out from October 2001 to September 2002. In total, 221 specimens accounting for 110 species, 3 subspecies and 7 varieties, were identified, belonging to 93 genera and 47 families. Of all, 17 were ferns and 93 were flowering plants. Among fern families, Polypodiaceae was the richest in number of species, i.e. 5 species in 4 genera. Among flowering plants, Orchidaceae was the richest in number of species, i.e. 23 species in 18 genera. The second richest families were Rubiaceae and Fabaceae with 5 species in 5 genera each, and Asclepiadaceae with 5 species in 2 genera. In another 14 families, 2-4 species were found in each while in the remaining 29 families, only 1 species was found in each. The common species of vascular plants in this area were *Pandanus unicornutus* St. John, *Lasia spinosa* (L.) Thw., *Glochidion littorale* Blume, *Calamus* sp., *Salacca* sp. and *Boesenbergia siamensis* (Gagnep.) P. Sirirugsa, an endemic species to thailand, was also found in the area.

Diversity of vascular plants in spring water swamp areas of Thong Pha Phum District, Kanchanaburi Province

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A Taxonomic survey of vascular plants was carried out in three spring water swamp areas in Thong Pha Phum District namely Pong Phu Ron, Phu Poo Rachinee, and Phu Chumchon Ban Tha Maduea from December 2001 to November 2003. A total of 493 specimens were collected. They were identified into 273 species, 205 genera and 87 families. These can be categorized into pteridophytes and flowering plants. Among these, 24 species in 17 genera and 12 families are pteridophytes, of which Polypodiaceae is the richest family of 8 species. The remaining species were angiosperms which comprised 170 species of the dicots, and 79 species of the monocots. Among the flowering plants, Orchidaceae was the richest family with 56 species. The second was Labiatae with 11 species in 6 genera while the third was Leguminosae-Caesalpinioideae with 10 species in 5 genera. In addition, six endemic species to Thailand were recorded, i.e., *Ardisia ficifolia* K.Larsen & C.M.Hu, *Ardisia confusa* K.Larsen & C.M.Hu, *Morinda scabrida* Craib, *Boesenbergia siamensis* (Gagnep.) P.Sirirugsa, *Aristolochia kerrii* Craib and *Magnolia siamensis*, Dandy var. *siamensis*; the latter two species are very rare. The other 4 species, viz. *Clematis smilacifolia* Wall., *Malleola penangiana* (Hook.f.) J.J.Sm. & Schltr., *Phalaenopsis parishii* Rchb.f., and *Renanthera coccinea* Lour. were also rarely found in this natural habitat. Moreover, there are a number of species which are said to be threatened in Thailand. They are *Acer oblongum* Wall. ex DC., *Mitrephora keithii* Ridl., *Aristolochia kerrii* Craib, *Thottea sumatrana* (Merr.) Ding Hou, *Epithema carnosum* Benth., *Chiloschista lunifera* (Rchb.f.) J.J.Sm., *Cleisostoma aspersum* (Rchb.f.) Garay, *Phalaenopsis parishii* Rchb.f., *Renanthera coccinea* Lour., *Calamus arborescens* Griff. and *Tacca chantrieri* Andre.

Sustainable utilization of vascular plants and rural technology transfer in West Thong Pha Phum

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The first year of a project on the development of the sustainable utilization of vascular plants and rural technology transfer in West Thong Pha Phum was undertaken by collecting data on vascular plants found in West Thong Pha Phum by BRT researchers. Twenty species were evaluated for their ornamental potentials, namely *Mitrephora keithii*, *Anaxagorea luzonensis*, *Asplenium nidus* var. *nidus*, *Donax grandis*, *Tacca chantrieri*, *Gardenia sootepensis*, *Melastoma malabathricum* subsp. *malabathricum*, *Dracaena loureiri*, *Tamilnadia uliginosa*, *Trevesia palmata*, *Caryota maxima*, *Angiopteris evecta*, *Magnolia liliifera*, *Schima wallichii*, *Magnolia liliifera* var. *liliifera*, *Paphiopedilum parishii*, *Clerodendrum wallichii*, *Dillenia parviflora*, *Dendrobium puchellum* and *Dendrobium scabrilingue*. Five species, *Gardenia sootepensis*, *Tamilnadia uliginosa*, *Magnolia liliifera* var. *liliifera*, *Asplenium nidus* and *Dendrobium scabrilingue* were propagated and cultivated for conservation and sustainable uses, demonstration plants and rural technology transfer to the West Thong Pha Phum area.

The diversity of stoneflies (Order Plecoptera) and black flies (Order Diptera: Family Simuliidae) in Thong Pha Phum Forest

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The study of the diversity of stoneflies and black flies from lotic habitats at Thong Pha Phum forest was divided into 3 disturbed areas, Pong Pu Ron, Ban Lam Pilok and Ban Prajammai, and 2 undisturbed areas, Ban Patsaduklang and Mae Nam Noi. Specimens were collected once a month in Year 1 from March 2002 to February 2003. Stonefly nymphs of 9 species were identified as follows: *Etrocorema* sp.[P1], *Neoperla fallax*[P2], *N. gordonae*[P3], *Phanoperla* sp.[P4], *Kamimuria* sp.[P5], Subfamily Perlinae[P6], *Cryptoperla* sp.[P7], *Amphinemura* sp.[P8] and *Indonemoura* sp.[P9] In disturbed areas 7 species were found namely as species P1, P2, P3, P5, P6, P7 and P8, while in undisturbed areas 8 species were found namely as species P1, P2, P3, P4, P5, P6, P7 and P9. For 17 species of black flies, larvae and pupae reared to adults were identified as *Simulium* (*Gomphostilbia*) *decuplum* [S1], *S.* (*G.*) *dentistylum* [S2], *S.* (*G.*) *duolongum* [S3], *S.* (*G.*) *parahiyangum* [S4], *S.* (*G.*) *siamense* [S5], *S.* (*G.*) *asakoae* [S6], *S.* (*G.*) *sheilae* [S7], *S.* (*G.*) *burtoni* [S8], *S.* (*G.*) *chumpornense* [S9], *S.* (*G.*) *novemarticulatum* [S10], *S.* (*Nevermannia*) *aureohirtum* [S11], *S.* (*Simulium*) *nodosum* [S12], *S.* (*S.*) *nakhonense* [S13], *S.* (*S.*) *quinquestriatum* [S14], *S.* (*S.*) *tani* [S15], *Simulium* sp. 1 [S16] and *Simulium* sp. 2 [S17] In disturbed areas 13 species of black flies were identified as species S3, S4, S5, S8, S9, S10, S11, S12, S13, S14, S15, S16 and S17, while in undisturbed areas 15 species were identified as species S1, S2, S4, S5, S6, S7, S8, S9, S10, S12, S13, S14, S15, S16 and S17.

Diversity of aquatic insects in some stream of Thong Pha Phum National Park, Kanchanaburi Province, Thailand

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A study was conducted on the diversity of aquatic insects in the area of Thong Pha Phum National Park at Thong Pha Phum District, Kanchanaburi Province, Thailand. Sampling was done 4 times from November 2001 to January 2003. Biological and physico-chemical properties of water were collected and measured from 10 sites. The aquatic insects were collected by using a Surber sampler and pond net. 11 orders, 91 families and 197 species (morphospecies) were identified. The greatest number of aquatic insects (8 orders, 58 families and 100 species) were found from Huai Khayeng III in the summer. The dominant family that was found in almost every study site was Baetidae, order Ephemeroptera. Diversity indeices were significantly different among seasons ($p \leq 0.01$). A statistics program, the ordination method of multivariate analysis (MVSP), was used to assess the water quality of each study site by using physico-chemical and biological data. The dendrogram, from cluster analysis showed two groups of study sites. The first group indicated the study sites that were undisturbed from residential areas, which was related to altitude. The second group indicated study sites that were disturbed from residential areas, which was related to alkalinity, conductivity, temperature, and pH.

Effect of local land use on benthic macroinvertebrates in headwater streams, Western Thailand

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Stream benthic macroinvertebrates were investigated at fifteen sites in each season within the Huai Khayeng and Huai Team streams at Thong Pha Phum District, Kanchanaburi Province, from December 2001 to May 2002. Benthos were collected using a Surber sampler and selected physico-chemical variables were measured *in situ*. All sampling sites were surrounded by different land uses (forested, agricultural and residential sites). The physico-chemical water quality data set of each sampled site was analyzed assessed by the ordination method of multivariate analysis. It showed that sampling sites were clustered into two groups: (i) the forested areas and sites far away from agriculture (ii) the agricultural and residential areas which were more disturbed. The latter group had high EC and TDS. The benthic community corresponded to water quality and land used and sampling sites could be discriminated into three groups: (i) the forested site (ii) the agricultural sites and (iii) the residential sites. The agricultural sites had lower taxa richness of sensitive groups (**E**phemeroptera, **P**lecoptera and **T**richoptera - EPT), but the percentage of tolerant chironomids was higher. The use of the multivariate approach for biological assessment more clearly illuminated the change of community structure along the environmental change gradient than did species richness and biotic indices.

Fairy shrimps in Huay Khayeng, Thong Pha Phum, Kanchanaburi Province

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Fairy shrimps live in ephemeral or temporary pools of rainwater, e.g. ponds, canals, rice field ditches, roadside ditches, grassy vernal ponds and woodland pools. They produce resting eggs or cysts, which are capable of withstanding unusual heat or cold and prolonged desiccation. During summer the resting eggs become dried in the bottom mud. Fairy shrimps are known to be a new type of live food in aquaculture because they are readily ingested, easily digested, having high essential growth factors and non-affected water quality. Additional they reach high individual biomass, have high reproductive ability and rapid growth. Fairy shrimp might also be used as ornamental animals, for aquatic toxicity testing and for treatment of waste from animal farms and agro-industries. Among three species of fairy shrimps found in Thailand, only *Streptocephalus sirindhornae* Sanoamuang, Murugan, Weekers & Dumont, 2000 and *Branchinella thailandensis* Sanoamuang, Saengphan & Murugan, 2002 are recorded as candidate species for the mass culture studies and aquaculture practices. These two species were not only found widely distribution on the flat plains of central, northern and northeastern Thailand but also on the high altitude mountain range in Huay Khayeng, Thong Pha Phum, Kanchanaburi Province. Although a proportion of temporary pools found fairy shrimps in Huay Khayeng was low when compared to in the lower area like in Muang district, Kanchanaburi due to the slope of landscape between mountains, the fairy shrimps were found distribution in all villages of Huay Khayeng. This existence may allow villagers in Huay Khayeng and nearby having their own stock of fairy shrimp for starting fairy shrimp culture.

Laboratory studies on the longevity, fecundity and reproduction of *Ceriodaphnia cornuta* Sars

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Seven neonates of *Ceriodaphnia cornuta* Sars were reared individually in each of 100 ml plastic vessels containing 50 ml of dechlorinated tap water at a room temperature of 21 to 40ºC and fed with *Chlorella* sp. at concentrations of 50,000–100,000 cells ml^{-1} every three days. The animals in culture vessels were examined 2 times a day to record fecundity, time to first reproduction, numbers of clutches, clutch size and longevity. Average time to first reproduction was 4.28±0.95 days. Average time between clutches was 26.52±2.02 hours and the maximum number of clutches was 22, the highest average number of offsping per brood was 11.85±1.86 and average total offspring was 98.14±14.49 neonates per female. The largest broods were the fifth to twelfth, depending on the individual. One female lived 18.0±4.54 days and during that time produced 15.85±3.62 broods. Neonates of *C. cornuta* of less than 24 hours old had an average body length of 0.46±0.20 mm and body width of 0.36±0.12 mm.

Hirsutella thompsonii Fisher collected from Thong Pha Phum Forest and effect of fungal metabolite on Tobacco Cutworm, *Spodoptera litura* (Fabricius)

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A total of 209 specimens of four-legged mites belonging to the families Eriophyidae and Diptilomiopidae and 5 specimens of spider mites from Tetranychidae infected with pathogenic fungi were collected from Amphoe Thong Pha Phum, Kanchanaburi Province, during November 2001 to November 2002. Out of all the specimens cultivated and isolated, 114 were identified as *Hirsutella thompsonii*. The 114 isolates of *H. thompsonii* developed well on malt extract agar (MEA) with an average growth rate of 0.06 to 0.23 cm per day at 27±1 ^{o}C, 65±3% R.H. Some isolates produced a water droplet, a clear zone and a synnemata. *H. thompsonii* produced flask-shaped phialide perpendicular to the mycelia. The distance between phialides ranged from 8.15-20.20 μm. Conidia were lemon-shaped with a rough surface. Fungal isolate #2220 produced the highest number of conidia and CFU ($191.68x10^4$ conidia/cm^2 and $181.70x10^4$ CFU/cm^2) on MEA plates. After growing in MEB (pH 6.5) for 4 days, *H. thompsonii* fungus #2459 produced the most dry weight of fungal biomass at 0.93 g/50 ml MEB and made the pH of the MEB equal to 8.9. Crude filtrates of all isolates except #2259 contained toxic metabolites inducing abnormal development of 4th instar cutworm larvae, *Spodoptera litura* (Fabricius). The toxic metabolites were found to cause mortality in the larval stages, incomplete pupation, incomplete adult emergence and abnormal adults. Toxic metabolites of 63 fungal isolates caused more than 50% abnormality in the cutworm with isolate #2444 causing 100% abnormality. Abnormalities of the cutworm larvae were increased when the concentration of crude filtrate was increased by protein precipitation with 90% saturated ammonium sulphate.

Diversity of Olethreutinae (Lepidoptera: Tortricidae) in Thong Pha Phum National Park, Kanchanaburi Province, Thailand

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Species diversity of Olethreutinae (Lepidoptera: Tortricidae) in Thong Pha Phum National Park, Kanchanaburi Province, Thailand, in 32 sites representing 3 habitat types of hill evergreen forest, dry evergreen forest and mixed deciduous forest was investigated. More than 700 specimens were collected by blacklight trap technique of 145 nights during 2001-2004. The 249 morphotypes were classified and divided into 6 tribes namely Bactrini, Enarmoniini, Eucosmini, Gatesclarkeanini, Grapholitini and Olethreutini. Of these, 109 species in 62 genera can be identified, of which 54 species are new records for Thailand. In addition 35 genera are still unidentified, with 53 samples that can not be identified in both generic and specific levels. *Eucoenogenes bicucullus* Pinkaew & Chandrapatya & Brown, 2005 and *E. vaneeae* Pinkaew & Chandrapatya & Brown, 2005 are previously described as new to science and *E. munda* (Diakonoff) was rearranged.

Diversity of araneid spiders (Araneae: Araneidae) and some their ecology in Western Thong Pha Phum Project Area, Kanchanaburi Province

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Species diversity of araneid spiders in Western Thong Pha Phum Project Area, Kanchanaburi Province, western Thailand between 2002-2005. A total of 251 specimens were belonging to 45 species and 19 genera 4 subfamilies (Argiopinae, Gasteracanthinae, Cyrtarachninae and Araneinae) and species richness are 10, 8, 2, and 25 species, respectively. The *Gasteracantha hasselti* C.L. Koch, 1838 is the most abundance species. I investigate the effect land use on araneid spiders richness are agriculture and village area, deciduous forest, dry dipterocarp forest, evergreen forest, and swamp area and species richness are 19, 29, 7, 14, and 3 species, respectively. Web level of araneids from 0.2 m. to more than 10 m. high that were categorized; below 0.6, 0.6-3.0, and more than 3.0 m. high and species richness are 21, 23, and 2 species, respectively. The most species richness were found spider web level between 0.6-3.0 m. high (66.62 %).

Biology of stingless bees (Apidae: *Trigona* spp., *Hypotrigona* spp.) in Golden Jubilee Thong Pha Phum Project, Thong Pha Phum District, Kanchanaburi Province

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A biological study of stingless bees (*Trigona* spp. and *Hypotrigona* spp.) in the Golden Jubilee Thong Pha Phum Project, from January 2004 to January 2006 found 126 nests of stingless bees. The bees were identified and were put into 2 genera and 8 species of which two species are anticipated as being new ones. The bees were *Trigona thoracica* Smith, *T. apicalis* Smith, *T. melanoleuca* Cockerell, *T. terminata* Smith, *T. collina* Smith, *T. iridipennis* Smith, *T. pagdeni* Schwarz, *Hypotrigona scintillans* variety1, *H. scintillans* variety 2, *H. scintillans* variety 3. The stingless bees which prefered to nest in hollow tree trunks always chose plants in the *Ficus* group. They were Banyan (*Ficus* sp.), Banyan (*Ficus religiosa* Bl.) and Bodh (*Ficus gibbosa* Bl.). *T. collina*, which nests in soil close to termite hills, mostly chose locations to build nests around the western sides of tree bases. The arrangements of brood cells inside nests were as follows: horizontal comb builders such as *T. apicalis*, *T. terminate*, and *T. pagdeni*; and cluster builders such as *T. collina*, *T. iridipennis*, *H. scintillans* variety 2 and *H. scintillans* variety 3. The life cycles of *T. apicalis*, *T. collina*, and *T. pagdeni* from eggs to adults lasted 35, 39, and 48 days, respectively. The stingless bees spent most time in pollen collecting from 09.00-11.00, in nectar collecting from 08.00-12.00, and in resin collecting from 14.00-17.00. Temperature and body size of the bees had a positive correlation but frequency of rainfall showed a negative correlation with the distance of flight for garbage dumping outside the nest.

Biodiversity and mass rearing of stingless bees (*Trigona* spp.) for lychi pollination in the Golden Jubilee Thong Pha Phum Project, Thong Pha Phum District, Kanchanaburi Province

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A diversity study of stingless bees resulted in 2 genera and 125 nests being found in the forest area of Huai Khayeng Subdistrict, Thong Pha Phum District, Kanchanaburi Province. Eleven species of these bees were identified as follows: *Trigona apicalis* Smith, *T. melanoleuca* Cockerell, *T. collina* Smith, *T. terminata* Smith, *T. ventralis* Smith, *T. iridipennis* Smith, *T. thoracica* Smith, *T. pagdeni* Smith, *Hypotrigona scintillans* Cockerell, *H. scintillans* var.2 and *H. scintillans* var.3. Four species namely *Trigona apicalis*, *T. collina*, *T. terminata*, and *T. pagdeni*, were observed to be suitable for colonization with high efficiency in lychee pollination. Summer was the right season for colonization with the optimum ranges of temperature for these four species being between 28 and 32°C. A lychee pollination study in February revealed that stingless bees preferred visiting lychee inflorescences on the east side of 4 year old lychee trees from morning till noon, followed by the south side and the west side. The least foraging was found on the north side. From the afternoon to evening, bees of nearly equal numbers dispersed to visit the inflorescences in all directions. Placing one nest in each corner of a 400 x 500 square meter plot was found to give the best efficiency for pollination by stingless bees as well as increasing yields of lychee. The next best thing was to place 4 nests in the same long row in the middle of the plot. Arranging 4 nests in groups in the middle of the plot gave the worst result.

The diversity of stingless bees (Apidae: *Trigona* spp. and *Hypotrigona* spp.) and their resin and gum collecting behaviors from nature in The Golden Jubilee Thong Pha Phum Project, Thong Pha Phum District, Kanchanaburi Province, Thailand

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All studies were conducted from April 2004 to March 2005 in the lower mixed deciduous forest, dry upper mixed deciduous forest, deciduous dipterocarp forest and dry evergreen forest at the Golden Jubilee Thong Pha Phum Project, Thong Pha Phum District, Kanchanaburi Province. The results showed that 2 genera (*Trigona* spp. and *Hypotrigona* spp.) and sixteen species of stingless bees were found in this area; namely *Trigona apicalis* Smith, *T. melanoleuca* Cockerell, *T. peninsularis* Smith, *T. canifrons* Smith, *T. thoracica* Smith, *T. terminata* Smith, *T. ventralis* Smith, *T. flavibasis* Cockerell, *T. iridipennis* variety 1, *T. iridipennis* variety 2, *T. iridipennis* variety 3, *T. iridipennis* variety 4, *Hypotrigona scintillans*, *H. pendleburyi*, and *H. klossi*. The last species was a new record in Thailand. Resin and gum collecting behavior was observed within a year from 20 colonies of 7 species. *T. apicalis* could be found in 4 types of forest. The diversity of *Trigona* spp. and their resin and gum collecting behavior mostly depended on environmental factors. The behavior showed differences in collecting from different alternative plants, and during different times and seasons. They prefered to collect the resin and gum from plants in 16 families such as Anacardiaceae, Dipterocarpaceae, Euphorbiaceae, Meliaceae, Hypericaceae, and Moraceae. During the rainy season, the foragers collected resin and gum all day; however the collecting behavior changed during the dry season to collection only in the afternoon until late in the day. *T. apicalis* collected resin and gum to make the largest number of propolis compared with the other bee species. Nest structures with walls had the highest resin. The propolis extracted from the nest structure could inhibit *Cladosporium cladosporioides* and *Sclerotium rolfsii*.

Nest size selection and life cycle of the red dwarf honey bee *Apis florea* and the black dwarf honey bee *Apis andreniformis* in Huai Khayeng Sub-District, Thong Pha Phum District, Kanchanaburi Province

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Nest site selection of the red dwarf honey bee, *Apis florae*, and the black dwarf honey bee, *Apis andreniformis*, will be studied in Huai Khayeng sub-district, Thong Pha Phum district, Kanchanaburi province. To investigate the nesting positions on trees in each species, the following factors will be studied: branch diameter of host trees, relative position of the nest in the host tree canopy, direction of the nest, shelter of the nest, height of the nest above the ground, size of the nest, physical and biological factors, architecture of the nest. Life cycles of workers, drones, and queens of *A. florea* and *A. andreniformis* will be compared. This research may be used as basic information for community villagers to understand the important aspects of bee biology in order to reserve and make decisions for conservation of natural resources in the future and to encourage sustainable resource utilization.

Ants on Huai Khayeng, Thong Pha Phum District, Kanchanaburi Province, Thailand

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The species diversity of ants was studied at Huai Khayeng, Thong Pha Phum District, Kanchanaburi Province, from January to December 2004. The objective focused on species diversity. Ants were collected in 4 forest types; 1) dry evergreen forest, 2) lower mixed deciduous forest, 3) dry upper mixed deciduous forest, and 4) disturbed mixed deciduous forest. A total of 202 ants species belonging to 56 genera and 9 subfamilies were found. The highest and lowest number of species occurred in the dry evergreen forest and the lower mixed deciduous forest, respectively. Nine ant species were highly adaptated to environmental changes. So, they showed regular distributions through the year and all forest types. Two clusters analyse of forest types and ant dispersion resulted in 3 groups related to activities and habitat. Two species can edibility.

Patterns of diversity and habitat relationships of terrestrial mollusc communities in the Thong Pha Phum forest area

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Twenty-four indigenous terrestrial mollusc species were recorded from the Thong Pha Phum forest area along with three alien species, *Achatina fulica*, *Lamellaxis gracile* and *Succinea* sp. Only three species were endemic, the two carnivorous snails *Atopos* sp. and *Discartemon* sp., and a diplommatinid microsnail, *Diplommatina* sp. *Cryptozona siamensis* occured in large quantity in all numbers areas while a tree snail species, *Amphidromus glaucolarynx*, occured in almost all areas in small numbers. Land snails preferred limestone habitats of neutral pH to a little basic. However, there were some species found in all habitats, such as *C. siamensis* and *Atopos* sp. Richness ranged from two or three indigenous species in home gardens and swamp areas to twenty-four species in a floristically rich limestone forest. Shell-shape distributions were essentially bimodal, with communities dominated by snail species with discoidal shells.

Ecological studies on river fishes in Central Thailand

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This report presents in abbreviated format some of the results of our ecological studies on river fishes in Thong Pha Phum and, in some cases, elsewhere in central Thailand. Seasonal changes in fish populations in Khayeng River varied inversely with discharge with maximum numerical abundance occurring during the dry season. Low populations during the rainy season when discharge is high were related to migrations from the study areas that were associated with feeding and reproduction. These results along with those for other rivers in central Thailand are more fully reported in Beamish et al. (2006a). Important habitat or environmental characteristics were identified for fishes found in Thong Pha Phum and elsewhere in central Thailand along with species distribution and population estimates, the latter by the depletion method. Species richness and numerical abundance were dominated by cyprinids followed by silurids and balitorids. Habitat factors of importance to species distribution and abundance are discussed.The results of these studies are described more fully in Beamish et al. (2006b), Beamish and Sa-ardrit (2006b), Beamish and Sa-ardrit (in review) and Beamish and Sa-ardrit (manuscript). Species coexistence was examined and related to resource sharing, facilitated through morphological adaptations and ontogeny. Morphological adaptations associated mainly with the mouth and digestive system direct species to forage on different dietary items with adaptations to body and fin morphology enhancing maneuverability or swimming performance both variously associated with prey capture and predator avoidance. These results are described in Ward-Campbell et al., (2005) and Ward-Campbell and Beamish (in revision). Morphological constraints direct some species such as *Channa gaucha* to exploit different food resources during ontogeny and these results are described more fully in Ward-Campbell and Beamish (2005).

Species diversity of amphibian in Thong Pha Phum District, Kanchanaburi Province

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Amphibian surveys were carried out in 3 types of habitat: natural habitat, human settlement habitat, and swamp at Thong Pha Phum, Kanchanaburi Province. A total of 37 species of amphibian were found. Thirty-two species were previously reported and other 5 species were first found in this areas. Two species were comsumped locally as food, *Limnonectes blythii* and *Hoplobatrachus rugulosus*. *Limnonectes blythii* was caught from the natural habitat and *Hoplobatrachus rugulosus* was found rearing in household level farming. Swamp is the key habitat of some species. Twenty-three species amphibians were found inhabiting 5 swamps: Forest Industry Organization Swamp, Phu Tha Maduea, Phu Nong Pling, Phu Pu Rachinee and Pong Phu Ron.

Species diversity, distribution and habitat characteristic of skinks in Western Thong Pha Phum, Kanchanaburi Province

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Species diversity, distribution and habitat characteristic of skinks in the swamp forest in Western Thong Pha Phum, Kanchanaburi Province, were studied each month during December 2006 to June 2007. Five study sites were chosen: Hot springs, Phu Tha Maduea, Phu Nong Ping, Phu Pu Rachinee and the swamp forest in Thong Pha Phum plantation of the Forest Industry Organization. Using the line transect method and pitfall traps, five skink species were recorded including *Riopa bowringii*, *Sphenomorphus maculatus*, *Mabuya multifasciata*, *Mabuya macularia*, and *Lygosoma quadrupes*. Phu Nong Ping had a higher taxa richness than did either Phu Pu Rachinee or the swamp forest in Thong Pha Phum plantation. *Sphenomorphus maculatus* was the most abundant in all study sites, whereas *Lygosoma quadrupes* was found only in Phu Nong Ping. The skinks lived mostly underground, hidden beneath logs, rocks, or among bamboo leaves and twigs.

Status of small carnivore in PTT Forest Reserve, Thong Pha Phum District, Kanchanaburi Province: A guideline for local community involvement in wildlife management

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The status of small carnivores in a small reserve called "PTT Forest Reserves" in Western Thailand was studied, to determine the effectiveness of a small protected area in wildlife conservation. At least 17 wild mammal species were present in this protected area including 10 carnivore species. The wildlife community in this area is dominated by viverrid species. Large Indian Civet was the most abundant, followed by Small Indian Civet and Common Palm Civet. A negative correlation between abundance of Large Indian Civet and distance to the forest edge showed the preference of this species for the edge area ($r = -0.682$, $p = 0.043$). There was a variety of human activities in this protected area and some activities were related with distance to the human community such as non-timber forest product collecting and domestic animals, which tended to have high frequencies near villages ($r = -0.831$, $p = 0.006$ and $r = -0.685$, $p = 0.042$ respectively). Even though mush research has been conductes in community land near protected areas it has not contributed positively to wildlife conservation. High levels of human (activities) and wildlife community dominated by viverrid species is an indicator of wildlife disturbance. So, conservation planning in this small protected area should aim at wildlife and at decreasing disturbing activities in the area, by partnership with local agencies, local people and local government and by making a roadmap to wildlife conservation in this area.

Participatory research and community dialogue as important tools for alleviating human-elephant conflict in Huai Khayeng, Thong Pha Phum, Kanchanaburi, Western Thailand

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Participatory research and community dialogue have been developed as important tools for alleviating human-elephant conflict in Huai Khayeng, Thong Pha Phum, Kanchanaburi, Western Thailand. The study found that 75 % of crop raiding by elephants (n = 122) occurs between 6 p.m. to midnight. Elephant behaviors responding to stimuli were used as baseline data to formulate community plans. Community dialogues, carried out 6 times using the data from field participatory research, have helped local leaders and the national park manager make decisions to solve human-elephant conflicts in the most intensive raided villages at Pak Lum Pilok village (32 raiding nights) and Huai Khayeng village (26 raiding nights). The assistance was set up by supplying financial support to buy repelling tools such as spotlights and firecrackers, and setting human-elephant conflict as a priority issue. Community dialogue also help to strengthen collaboration among villages by exchanging and adjusting the repelling methods and organizing urgent gatherings for repelling experienced elephants. Community plans help villagers repell elephants unharmed. For a long-term solution, community dialogue, participatory research and evaluation of field research data will ensure best practice for coexistence humans and elephants.

Non-cropped vegetation in relation to insects and soil mites found in two farming systems and a forest edge in Thong Pha Phum, Kanchanaburi

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The composition of plants, insects, and soil mites in non-cropped areas were compared between an organically certified farm, a chemically intensive farm, and the forest edge adjacent to the two farms. Plants were identified from non-cropped vegetation and percent coverage estimated within 1x1 m^2 quadrats. Insects were sampled from the non-cropped vegetation by using sweep nets, and soil mites and soil insects were separated from soil samples by using Berlese's funnels. The dominant plant species varied from area to area. Ya-Ca or Cogon grass (*Imperata cylindrica*) was most prevalent in the organically certified farm especially in an open canopy area while Kok-Dok-Khew or Kyllinga (*Cyperus brevifolius*) was ubiquitous in the chemically intensive farm. In the forest edge, Sab-Seu or Siam weed (*Chromolaena odorata*) was the dominant species. Besides the differences in management practices between the three areas, the high diversity indices of above ground insects and soil mites found in the forest edge suggests that *C. odorata* might be a potential reservoir for beneficial insects, especially parasitoids. Data analyses to determine seasonal variation is in progress.

Development of sentinel systems for pesticide contamination in agricultural areas of the Thong Pha Phum region

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Agriculture is an important activity in the Thong Pha Phum region. Cultivation of field crops, rice and horticulture require an extensive use of pesticides to control pests and weeds. These pesticides may contaminate the natural environment and affect the health of organisms in the area including humans. The current research project aims to develop sentinel systems for pesticide contamination, which include 1) a database of pesticide use in the Thong Pha Phum region and 2) the biological responses of the sentinel animal species. Questionnaire surveys on pesticide use were conducted with farmers from Tambon Lintin and Tambon Huay Khayeng of Thong Pha Phum District, and field surveys for potential sentinel species were conducted in natural habitats overlapping the agricultural areas. The surveys show that methomyl, methyl parathion, glyphosate and paraquatdichloride are major pesticides used in the study area. These pesticides vary greatly in their toxicity, potential contamination and accumulation in the ecosystem. The results also suggest a possibility that farmers in the area may use large quantities of one or more pesticides at the same time, leading to contamination of the environment with pesticides. Information on pesticide use will be developed into a database and used to categorize pesticides that need to be monitored. In addition, several species of freshwater snails have been selected as potential sentinel species. The biological response of these sentinel species together with the database of pesticide use could be of importance for risk assessment of pesticide contamination in natural ecosystems as well as human settlements.

Assessment of appropriate tourism programs for Huai Khayeng, Thong Pha Phum District, Kanchanaburi Province

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Huai Khayeng is located in Thong Pha Phum District, Kanchanaburi Province. The Huai Khayeng community was relocated from the plains area due to the construction of Vachiralongkorn Dam which has resulted in them changing their lifestyle from natural product consumption to the use of natural and cultural attractions for tourism. In the past few years, Huai Khayeng was managed for tourism programs by various people. However, it was not successful. In order to survive, the tourism programs are in need of revision. Thus, the objectives of this research are to (1) study the causes of failures in tourism management programs in Huai Khayeng, (2) to evaluate the prior tourism management programs and marketing factors of Huai Khayeng, (3) to recommend proper tourism management programs for Huai Khayeng. Research methodology comprises meetings of focus groups, the use of questionnaires and interviews of stakeholders in the tourism business. The study results will be useful for the community for revising and improving tourism management and increasing the efficiency of tourism management to suit both natural resources and the community.

Management of conservation forest under the 72 Phunsa Maharat Thong Pha Phum Forest Project as a buffer zone for Thong Pha Phum National Park

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The objectives of the study are: (1) to analyze the socio-economic status of surrounding communities, their existing uses of resources from the conservation forest, and their opinions regarding management of the forest as a buffer zone; (2) to analyze the potential management of the conservation forest under the 72 Phunsa Maharat Thong Pha Phum Forest project as a buffer zone that is acceptable to all concerned parties, and (3) to analyze the economic viability of management of the forest as a buffer zone. The participatory rapid appraisal (PRA) method was applied for the proposed management plan and the cost benefit analysis (CBA) method was applied for its economic viability. The results showed that the community collects non-timber forest products mainly for consumption, while some products are sold for earning income. Forest utilization may not be sustained as there are no reforestation and rehabilitation programs. Being conservation forest under the 72 Phunsa Maharat Thong Pha Phum Forest project, the area is a resource for conducting research in biological diversity. This helps the community to gain knowledge and understanding of the significance of biological diversity and forest resource conservation. This study provides preliminary data for buffer zone management in the 72 Phunsa Maharat Thong Pha Phum Forest project. Buffer zone management strategies will be discussed by proposing strategies acceptable to all concerned parties including government and private agencies. Analysis of the economic cost for management of the conservation forest under the 72 Phunsa Maharat Thong Pha Phum Forest project as a National Park buffer zone will also be conducted.

A study of local peoples' knowledge on non-timber product utilization and transformation to local production

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Thailand has a rich flora with a wide variety of plants. Non-timber forest products have been used since ancient times for consumption and selling. The aim of this study is to improve the relationships between humans and nature at Thong Pha Phum plantation, Kanchanaburi Province, because ethnic people are very knowledgeable about non-timber forest product utilization. Data collection was designed to investigate local opinions and knowledge on using non-timber forest products and their transformation to local products with economic value, and the dependence of local people on forest resources, by using questionnaires for data collection. Moreover, there are plans to explore non–timber forest product species diversity. Chi–square is a statistical technique used in data analysis and statistical significance is set at 0.05. There are three study areas located in Tumbon Huay Khayeng, Thong Pha Phum District, Kanchanaburi province at three villages, Ban Tha Madeau, Ban Raipa and Ban Rai. Each village is a representative of Thai, Karen and Burmese communities, respectively. It is hoped that the results of this study will be used as fundamental data for making decisions about economic possibilities for developing projects in the governmental and private sectors, as well as using the results of the study as a guide for policy determination in Thong Pha Phum plantation management and for use of non-timber forest products effectively and sustainably.

Dialogue as a tool for approaching community tacit knowledge: lessons from Huay Khayeng

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The article is to show how dialogue is applied for working with multi-stakeholders from different socio-cultural background in Huay Khayeng, for example, Karen, immigrants, exogenous, local elites and scientists. It is to understand how they identify their situation in the local area. The initial results show that differences in identification of the situation among multi-stakeholders are too obvious. People from different groups see themselves extremely different from each other. There is no coherence of thought among people in this locality. This article suggests that the dialogue process for thinking together must be developed to facilitate people from different backgrounds to come and share their meanings. By doing so, the level of consciousness can be lifted up and a new definition of the local situation consequently will emerge.

The Rural Ecological Agriculture for Livelihood (REAL) Project for Kanchanaburi and Nakhon Si Thammarat Provinces

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Thailand farming communities have been using natural biodiversity found in and around their farms for many livelihood functions including food, income, medicine, home tools and materials, and cultural activities. Nowadays, the availability of bio-diversity in the farmland is becoming scarce and/or has completely disappeared in many parts of Thailand. The degradation of farmland bio-diversity stems from farming methods which negatively alter the physical habitat of various plant and animal species, expansion of urban boundaries into farm areas, and pesticides. As a result, some important species have disappeared or their populations have become drastically reduced forcing communities to look for other sources of income, buy foods which they normally had for free and purchase other essentials that they previously were able to collect on their own farmland. The Thai Education Foundation (TEF) has been funded by BRT to pilot the development of the "Rural Ecological Agriculture for Livelihood" (REAL) Project in Kanchanaburi and Nakhon Si Thammarat provinces. The REAL project aims to build capacity of schools and communities to understand the importance of their farmland biodiversity and develop local level plans to conserve species that are important for community livelihoods. Participatory Action Research (PAR) is embedded in the learning process with the intention to produce community habitat action plans and support by research, as well as locally developed curriculum by participating schools.

Conservation planning and local knowledge development related to farmland biodiversity

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At present, we are all aware that biodiversity in farmlands is under threat. To preserve and recover farmland biodiversity, the community needs to have a conservation and utilization plan. For effective planning, the community has to gather all local knowledge and at the same time they also need to find new knowledge. So it is necessary to build the community's capacity to be able to conduct simple experiments. A project has been initiated in Nan Province in Reung, Chaisathan and Kongkuay Sub-districts, Muang Nan District, and DuPong Sub-district, Santisook District. The project's goals for each Sub-district are (1) to prepare a habitat conservation and utilization plan related to farmland biodiversity and (2) to develop local knowledge related to farmland biodiversity through community researchers. In addition, the project is also targeted at (1) studying the progress of habitat conservation and utilization plans in previous work areas, and (2) establishing a network for scaling up conservation planning and local knowledge development. The work has been conducted since May 2007.

Undergraduate Research Competence Program in Farmland Biodiversity (URCP/FBD)

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The goal of the URCP is to give students opportunities to conduct original research with farming communities on challenging issues related to farmland biodiversity. The immediate objective is to train students in their third or fourth year of studies to have capacity to conduct independent research on FBD. Seven undergraduate students from Rajabhat Phiboon Songkhram and Prince of Songkra Universities, and one Laotian Master student in Women studies at Chiang Mai University were participants in a four-week training workshop from April 27 to May 23, 2007. The classroom session was extended for 10 days to provide students with principles and practices in community action research and in integrating biodiversity in agricultural and forest landscapes. Interactive learning approaches were used to motivate students' interests and improve their understanding. These included short presentations, group discussions, role play games, case studies, and farmer presentations on biodiversity and rural livelihoods. Two students took turns to evaluate content and training methods everyday to help improve the next lesson. Individual students conducted self-evaluation on levels of participation and learning motivation. Field trips to proposed research sites were arranged to familiarize students with community research techniques. Students individually formulated research proposals and conducted independent field research on seven topics in three selected ecosystems. Students gave seminars on their research findings with Power-Point presentations. The students' written reports were corrected through email during the term before final submission. Three main factors enhancing students' capacity were 1) group learning dynamics, 2) virtual teaching tools, and 3) an interactive learning environment.

Enhancing farmland biodiversity in traditional rice-based agricultural landscapes of Phayao Province

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Smallholder rice farmers of Northern Thailand have integrated agro-biodiversity into their production landscapes to enhance livelihood diversification through various means, depending on the suitability of physical and natural assets. This study explored biodiversity in agricultural landscapes of Phayao province using a community action research approach. The objective was to develop common understanding and to strengthen capacity of rice farmers to regenerate, improve, and maximize the benefits of biodiversity through collective action. A farmer motivation workshop was first organized to include representatives of Phayao's Tambon Community Rice Seed Production Groups to review ecosystem, species and genetic diversity in agricultural landscapes, and to identify and establish strategies for incorporating a biodiversity agenda into farmers' production plans and practices. Four rice ecosystems and farming practices were selected for farmer capacity building. These were 1) multiple cropping in irrigated lowlands, 2) integrated farming in rainfed lowlands, 3) organic rice in flood-prone rainfed lowlands, and 4) mosaic land use systems in the lowland-hillslope interface. The participatory learning and action approach was implemented with selected groups at different sites. Field surveillance on species diversity across ecosystems was carried out as a group activity. Non-marketable plant species, wild plants, and mushrooms in different habitats contributed to daily household food requirement throughout the year. Overflow of the Ing River provided significant fish species for food and for cash for farm households in flood-prone lowlands. The studies showed that enhancing biodiversity in agricultural landscapes would require new types of communication, cooperation and research approaches among multi-stakeholders to develop common understanding for agro-biodiversity management.

Collective action in agro-biodiversity management for sustainable rural livelihoods in freshwater wetlands: A case study at Sakon Nakhon Province

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Wetlands deliver a wide range of ecosystem services vital for human well-being and poverty reduction. The Lower Songkhram River Basin (SRB) in Northeast Thailand, where flooding is an integral part of the annual hydrological cycle and wet season landscape, provides life supporting systems for villagers of Nakhon Phanom and Sakhon Nakhon Provinces. A case study was conducted at Ban Dong Sarn, Sakhon Nakhon Province, where villagers have adapted livelihood diversification based on rice, fish and aquatic resources, forest resources and livestock. The objective was to enhance local competence in planning and management of agro-biodiversity resources in freshwater wetlands through collaborative learning and better information management. Key community leaders, farmers and school teachers were invited to participate in a planning workshop to identify a possible research agenda and to collaborate in research activities in relation to management of agro-biodiversity. Five distinct ecosystems which are closely linked to rural livelihoods were identified for community-based biodiversity management. These included: 1) Songkhram River and ox-bow lake for aquatic resources conservation and utilization, 2) community forest land, 3) upper terraces which are traditionally used for rainy season rice cultivation, 4) flooded lowlands where only dry season rice is cultivated, fragmented with natural ponds which are community-managed for fishing enterprises. 5) Tung Phan Khan wetlands where half of the seasonally flooded forestland (*paa bung paa thaam*) had recently been converted to farmland for dry season rice cultivation. The linkages between social mechanisms and ecological diversity have shown promising results in collective management of agro-biodiversity in wetlands.

Gender knowledge in conservation and utilization of agro-biodiversity in forest and agricultural landscapes of Vientian Province, PDR Laos

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PDR Laos is an agrarian society with about 80 percent of its population engaged in farming. Biodiversity-rich natural resources contribute significantly to livelihood support systems. Forest and farmland ecosystems are of great importance for impoverished rural communities, especially for women who live in marginalized areas, for collecting plant genetic resources for food, medicine and rituals. Research on gender relations in agriculture reveals that there is gender division of labour in farming. The knowledge and use of plant species is gender-differentiated. Since women work in the kitchen, they are generally considered to be the gatekeepers of food flow in and out of households. Culinary traditions are thus closely related to women's knowledge on use and conservation of agro-biodiversity.

Key research questions are:

1. How do gender relations in rural Laos help enhance conservation and sustainable use of agro-biodiversity?
2. How does loss of agro-biodiversity as a consequence of environmental degradation in forests and farmlands impact on women?

Research objectives:

1. To identify habitats, distribution and abundance of plant biodiversity used by rural households
2. To determine the use and value of plant biodiversity, and its impact on food security and household livelihoods
3. To differentiate gender knowledge on use and conservation of plant biodiversity in forests and farmlands
4. From the farmers' perspective, to analyze the potential threats to sustainability of plant biodiversity in the studied areas.

Research area:

The research will be carried out in Ban Pia, Pone Houng district, Vientian, PDR Laos.

Local organizations and institutional linkages in agro-biodiversity management and conservation

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Many successful cases of community-based natural resources management and conservation have achieved conservation goals and development needs together. Among the driving forces are strong leadership of local groups, and their ability to negotiate and link with external agencies to maximize the benefits of institutional collaboration in resources management and conservation. This paper describes roles and functions of local organizations in managing and conserving biodiversity to benefit local communities in Ban Pa Sak Ngam, Tambon Luang Nue, Doi Saket district, Chiang Mai province, and investigates the relationships between local organizations and external agencies that lead to successful co-management of natural resources. Through interaction with the Royal Initiative's Huai Hong Khrai Development Learning Center (the Center), the community of Pa Sak Ngam has set up various social groups, such as the Forest Protection Group, Forest For Life Group, Youth Group, etc, to collectively regenerate and protect forest resources for sustainable use. The village committee which consisted of different age groups with strong intergenerational relations proved to be visionary, providing guidelines for integrating conservation and development. With strong support from the Center, many social innovations from the village were extended to other groups and villages within the Center's network. Through strong social relations within the community and with external agencies, collective achievements included water conservation through check dams, an effective forest fire control program, conversion of forest biomass into organic compost for agricultural use, an environmental studies camp for schools and the general public, and a community library.

From monoculture to polyculture of vegetable production systems: farmers' perspectives toward biodiversity services to sustainable livelihoods

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Vegetable farmers in peri-urban areas practicing monoculture systems are facing decreasing marginal returns due to price uncertainty, pest incidence and high input costs. Conversion to pesticide-free or organic management provides ecological and economical solutions only when biodiversity is integrated into the production system. Many attempts to commercialize organic monoculture vegetable systems fail because of their uniformity. This study aimed to determine, from the farmer's perspective, biodiversity services to farming households that had converted to pesticide-free vegetable polyculture systems. The conventional systems were used as benchmarks for comparison. The polyculture system was dynamic with 23 species planted over the seasons based on species adaptability. Each species was planted on small plots about 5-10 m^2 with different rotations. The system showed insignificant pest damage, and harbored both pests and natural enemies more than did conventional systems. With a small plot size for each species, uniform application of a mixture of chemical fertilizer and organic compost was much easier, and resulted in higher yield. With increasing use of the fertilizer and organic compost mixture, farmers indicated that the soil was easy to work, and more earthworms were found. Farmers spent more time on-farm to manage the bio-diverse system than they did for the conventional system. Farmers claimed that monthly income from a pesticide-free vegetable polyculture system was almost double that of a conventional system, with an average gross monthly income of Baht 70,000 from a 3 rai plot. The case study illustrates that enhancing agro-biodiversity practices with emphasis on polyculture of diverse species and on fertilizer management, a pesticide-free production system is ecologically and economically viable.

Sustainable use and management of wild mushroom biodiversity in a marginalized community of Northern Thailand

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The livelihoods of rural communities in marginalized uplands of Northern Thailand are closely linked to the ecological integrity of forest resources. Extraction of non-timber forest products (NFTPs) and unattended free-grazing of livestock are common utilizations of forest land. Many cases of unrestricted demand for a finite resource ultimately doom the resource through over-exploitation. Such social traps follow the "tragedy of the commons". Community forest is one solution where common pooled resources are collectively managed through regulatory systems. A case study was conducted in Ban Pa Sak Ngam, Doi Saket district, Chiang Mai province, to investigate how farmers manage the biodiversity of wild mushrooms to supplement their needs. Local forest experts on wild mushrooms were approached to help explore habitats and identify edible wild mushrooms. Nine habitats distributed over four types of forest, dry dipterocarp, deciduous, dry evergreen, and moist hill evergreen forests, were located. Ten wild mushrooms, which are distributed differently over time from May to December in different habitats, provided food and incomes. During the season, individuals could earn from wild mushrooms between 300 and 500 Baht per day. Regulatory systems were imposed to protect forest from encroachment and over-exploitation. Local members and visitors coming for mushroom gathering were informed about rules and regulations of forest protection. Within the community, mushrooms were often given to neighbors as "gifts", or exchanged for other food items. Mushroom trading occurred with outside buyers. This mushroom case study indicates that collective management of natural resources supplemented with regulatory systems could result in sustainable use of mushroom biodiversity.

Local knowledge on conservation and utilization of the wild plant species *Melientha suavis* Pierre in dry Dipterocarp dominated forest of Ban Pa Sak Ngam, Chiang Mai Province

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Culinary traditions and preferences required to provide edible and culturally acceptable food have a marked influence on the knowledge, selection, use and conservation of plant biodiversity (Howard, 2003). Plant species selection for food entails more than culinary knowledge and skill, it also relates to local ethnobotanical knowledge and skills required to maintain, domesticate and propagate wild plant species. This study explored local ecological knowledge of *Melientha suavis* Pierre or Pak Waan Pah with emphasis on species habitat, uses, and community conservation practices for sustainable use. The field study was conducted at Ban Pa Sak Ngam, Tambon Luang Nue, Doi Saket district, Chiang Mai province, where the community's livelihoods traditionally depended on forest resources. Key community leaders, village social and functional groups were approached to discuss research interests and objectives. Local experts on *Melientha* species were identified, and a woman's group was included for culinary knowledge. One edible *Melientha* species was identified in eleven habitats of dry Dipterocarp dominated forest of which three habitats, characterized by a gravel-soil mixture were most abundant. Women and men gathered wild species of *Melientha* during March-May when young leaves were about 15-20 cm long. During the season, each household on average consumed Pak Waan Pa three times per week. At least six common dishes were prepared from Pak Waan Pa. A few households gathered the species for local market, earning Baht 70-80 per day for 2 kg of young leaves. With a successful community habitat action plan, there was no motivation for farmers to domesticate the species.

Agro-biodiversity conservation and utilization in vegetable-based farming systems in peri-urban areas of Chiang Mai province

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Peri-urban farming systems have become important food sources for increasing urban populations. Biodiverse vegetable-based production systems are often thought to be economically unviable. However, farmers who have converted from chemically-based monocultures to pesticide-free vegetable-based polycultures have successfully managed crop diversity as an economic strategy. By combining polycultured fields and home gardens, farmers have created their own economic niche that provides stable daily incomes. This paper describes agro-biodiversity in production fields and home gardens of a peri-urban village specializing in commercial vegetable production. It specifically aims to determine the extent to which agro-biodiversity is being used and conserved by farming households. The case study was conducted at Ban Ping Noi, Saraphi district, Chiang Mai province, where 93 percent of 193 households engage in farming. The agro-biodiversity survey which was limited to vegetable species identified 78 species found in fields and home gardens, among which 44 were food crops and 34 were herbs and medicinal plants. Within food crop species, 26 were produced commercially, and 18 were home garden types. For commercial vegetables, farmers preferred fruit types to others. For home gardens, leafy vegetables were selected. Of those used for medicinal purposes, the majority of usable parts were leaves. Among 34 medicinal plant species, six were commonly found in all households for treatment of soar throat, muscular pain, bleeding stoppage, itching relief, and tonics. Consumption patterns of different age groups were determined. Four-cell analysis was used to differentiate species abundance and preference according to planted areas and households.

Enhancing biodiversity in irrigated rice-based farming systems

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Enhancing biodiversity is seen as a way to increase the effectiveness of sustainable farming practices by integrating biodiversity conservation into production landscapes. This paper explores cropping diversification in irrigated rice-based farming systems through focusing on integrating biodiversity-friendly management practices within local level conditions. The case study was conducted at Ban Dong Palan, Mae Taeng district, Chiang Mai province, where land use intensification has been made possible through irrigation and tube-well systems. Crop rotation, which was the main farming feature, included rice-soybean and rice-sweet corn in the irrigated lowlands. The maize-based systems were dominant in sandy loam areas where water was supplemented by tube-wells. In the sweet corn system, where crops are early maturing, farmers relay-planted egg plants or chili pepper when sweet corn was one month or 7-10 days after seeding, respectively. Cultural practices considered to enhance biodiversity included 1) pesticide-free and frog protection in rice farming resulting in varieties of edible aquatic vegetables, 2) soybean rotation with rice under minimum tillage provided less soil disturbance, 3) use of soybean thresh for mushroom production, and use of by-products such as compost added value to soybeans, 4) increased use of organic fertilizers in rice and vegetable crops, and 5) decreased use of herbicides in sweet corn and glutinous corn resulting in the emergence of edible Amaranth species. The case study shows that with proper cultural practice, biodiversity could be enhanced and could lead to sustainable farming intensification.

Women's knowledge on use and conservation of plant biodiversity in irrigated rice-based farming systems

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Culinary traditions are closely linked with biodiversity conservation. Since women's work in food preparation is usually based on locally available plant and animal resources, it is therefore considered essential for biodiversity conservation. The knowledge and skills of culinary traditions which are transmitted from mother to daughter have significant influences on selection, use and conservation of plant biodiversity. This paper explores women's knowledge on plant biodiversity that provides edible and culturally acceptable food, and the ways these food plants are conserved and used. A case study was conducted in collaboration with women members of family households in Dong Palan village, Mae Taeng district, Chiang Mai province. Year-round irrigation systems provided favorable growing conditions for food crops, cash crops and non-cash crop species. The case study showed that 58 plant species that were culinary traditional plants, among which 34 were cultivated mainly as home garden crops providing household requirements throughout the year, while 24 naturally occurring species were seasonal. The plant species were consumed as daily vegetables and prepared in a variety of ways in traditional Lanna Thai cuisine, of which mixed vegetable curry was the most common dish. The edible parts included newly opened leaves, expanding leaves, floral parts, fruits, and stems. This case study provided good evidence for the interrelationships between women's knowledge of culinary traditions and plant biodiversity. Home gardens have become places of *in situ* conservation of edible crop plants and herbs.

Socio-economic contributions of agro-biodiversity to the livelihoods of smallholder farmers

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Agricultural intensification has led to widespread decline in agro-biodiversity across different levels, from reducing numbers of crop species and varieties to decreasing natural enemy species. On the contrary, agro-biodiversity enhancing land use systems are multifunctional, producing a whole array of ecosystem services, besides biomass production, that have socio-economic impacts on livelihoods of smallholder farmers. This study was carried out to determine the socio-economic contributions of ago-biodiversity to the livelihoods of smallholder farmers in three sites with different land use systems in Chiang Mai province, Northern Thailand. The three sites included peri-urban, vegetable-based land use, irrigated lowland rice-based land use, and upland agro-forestry based land use systems. Participatory Rural Appraisal (PRA), key informant interviews, participant observations, and field surveys were used to understand the context of the three study sites. Field data obtained by student training were used for synthesizing case studies. The socio-economic impacts on food security, income stability, and social relations within households and in communities were emphasized. The three sites showed different complexities of agro-biodiversity. The highest was observed in the agro-forestry based system, which also showed the highest achievement in social relations where collective action was embedded. The biodiverse vegetable-based system produced stable and high farm income, but achievement was more individualistic. The irrigated rice-based system, with its limited crop choices, was vulnerable to price changes. It was generally observed that agro-biodiversity enhancing land use practices can increase food production and produce higher flows of ecosystem services, and can improve socio-cultural values, but the extent of these contributions has yet to be quantified.

นิเวศวิทยา

Wetland plant and aquatic macroinvertebrate communities of The Lower Central Plain: A case study at Salaya Campus, Mahidol University, Nakhon Pathom, Thailand

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A case study at Salaya Campus, Mahidol University, Nakhon Pathom Province, illustrates the problems of wetland degradation in the Lower Central Plain of Thailand. To fill the gap in knowledge on wetland ecology, a preliminary study of wetland plant and aquatic macroinvertebrate communities was conducted during November to December 2006. Twenty-eight sampling stations were set to cover an area of 8 ha of the campus wetlands. Dipnetting was used for sampling aquatic macroinvertebrates; then sorting and identification to Family level were done in the laboratory. At the same sampling stations, 1x1 m quadrat sampling was applied to estimate percent coverage of plants. Water depth was also measured. Based on the results the campus wetlands were classified as freshwater marshes where 36 species of plants were found with a Shannon's diversity index of 2.6. Among these, 22 species are facultative upland, 6 species are facultative wetland, and 8 species are obligate wetland plants. A transitional zone occurred between upland and wetland plants in this area at approximately depths of 0-25 cm covering 1.17 m of transects. Dynamic water levels caused zonation to occur in the wetland. The number of plant species tended to decrease as water level increased. For aquatic macroinvertebrates, at least 56 Families were identified. Shannon's diversity index was 2.5 for this community. Lymnaeidae, Chironomidae, and Planorbidae were the three most abundant taxa. The number of macroinvetertebrate taxa was not related to water level. However, it tended to have a positive correlation with the number of plant species. On the basis of wetland plant and aquatic macroinvertebrate communities, biological metrics for wetland assessment will be developed.

Avian abundance and diversity: an assessment of monitoring methods for forest birds at the Mo-singto Long-term Biodiversity Research Plot, Khao Yai National Park

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Little is known about the basic population ecology of Thai birds, particularly abundance, fecundity, and survival. Our objective was to conduct an intensive study of an evergreen forest bird community to estimate abundance of all species and assess the accuracy of different survey methods, and determine details of species ecology. Line-transects, point-counts, and spot mapping on the 30-hectare Mo-singto Plot, Khao Yai yielded >23,000 observations of 154 species of birds (2003-2006). The density was 2930 birds/km^2, similar to communities in Panama. The Puff-throated Bulbul had the highest density (300 individuals/ km^2), while >85% of species had densities < 100 individuals/ km^2. Spot-mapping of colour-ringed birds provided the most accurate estimates of abundance, but did not work for all species. Distance sampling provided relatively accurate estimates of abundance more efficiently than spot-mapping, but was also unsuitable for some species. The estimates from line transects were somewhat better than from points. Birds were easiest to detect in March before the peak in nesting in April-May. November was the month where birds were the quietest. Most species completed breeding between January and August. We monitored 688 nests, one of the world's largest samples from a forested site in the tropics. Nesting success in most species was <25%, similar to other studies in the tropics. The chief cause of nest-loss was predation, especially by Pig-tailed Macaques. We colour ringed 1,207 birds which has enabled estimation of territories, movement patterns, and fecundity. Studies of survival are on-going. Other outputs include training of more than 12 Thai students and the publication of 12 international/regional papers.

Determining nest predators of understory forest birds using digital video surveillance at Khao Yai National Park

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Nest predation is the primary cause of nest failure for many bird species. However, predation events are rarely seen and the predators are generally unknown. We developed a system using digital video recorders (DVR) to monitor nests in the understory of seasonally wet forest at Khao Yai National Park. Up to four DVR-camera systems were deployed during January - August 2006 & 2007 to monitor open cup, cavity and ground nests. A total of 710 days of active nesting was recorded at 72 nests of 11 species. 50 nests (74 %) lost at least one egg or nestling of which 44 (88 %) were due to predation. Non-predation failures included structural damage and starvation of nestlings. We recorded 5 different types of predators: the Pig-tailed Macaque, *Macaca nemestrina,* (18) rodents (7), birds (9), snakes (9) and the Common Palm Civet, *Paradoxurus hermaphroditus* (1). The civet and snake predation events were nocturnal. Two attacks by rats occurred at night while the remaining rodent events (tree shrews and squirrels) were diurnal. The Green magpie, *Cissa chinensis* (4) and the Crested Goshawk, *Accipiter trivirgatus* (3), were the most frequent bird predators. Cavity nests were depredated by snakes, macaques and a Crested Goshawk. Ground nests were depredated by a civet, macaques and a Crested Serpent Eagle, *Spilornis cheela*. Open-cup nests were depredated by snakes, macaques and birds. The high number of predation events caused by macaques deserves further attention to determine whether their populations have been increased by their habituation to humans in areas close to the study area.

An investigation of group composition of the cooperative-breeding Puff-throated Bulbul (*Alophoixus pallidus*) in Khao Yai National Park

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The Puff-throated Bulbul (*Alophoixus pallidus*) is one of the most common birds in evergreen forest in central Thailand and current evidence suggests that it is a very important seed disperser. It also has a complex social structure, including cooperative breeding which is poorly understood. Furthermore, recent evidence suggests that cooperative breeders may be particularly sensitive to habitat degradation, and fragmentation, and thus the reduction of such species could have significant effects on normal forest regeneration processes. The project objectives were: a) to investigate group size and the proportion of the Puff-throated Bulbul population engaging in cooperative breeding, b) investigate the relationship between group size and nesting success, and c) investigate the contribution to reproduction as well as to parental care provided by each flock member during different stages of nesting. The study is being undertaken on the Mo-Singto Long-term Biodiversity Plot, Khao Yai National Park. Preliminary results of this study indicate that Puff-throated Bulbuls live in groups of 2–7 individuals (average of 3.6 individuals per group). From observations at nests, feeding rates were 2.51 visits/hr. The primary female adult provided most of the parental care and insects were the main type of food fed to the nestlings (57.25%). We found that a larger group size and more helpers increased daily survival rates of nests from the egg stage until the nestling stage although the difference was not significant. Further work will help determine how group size affects nest and nestling survival.

Post-fledging survival and juvenile dispersal of the Puff-throated Bulbul (*Alophoixus pallidus*)

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Juvenile survival has a significant impact on population dynamics. The Puff-throated bulbul (*Alophoixus pallidus*) is the most abundant bird species in evergreen forest at Khao Yai National Park. These birds live in groups. This study focuses on a population in the Mo-Singto Long-Term Biodiversity Research Plot. Mist-netting and individual marking have been initiated to collect a variety of data including survival, group organization, territoriality, dispersal, and breeding behaviour. Preliminary results suggest that the survival of juvenile birds is relatively high (76%) if they survive the early post-fledging stage. In the majority of cases the cause of death was unknown, but presumably caused by predation, particularly by raptors as young fledglings are susceptible due to their weak flying ability. Juvenile birds started to feed independently when they are about 4 weeks old, but still got fed by adults in this weaning period. All juveniles stay in their natal territory for at least 28 weeks after fledging. Moulting started soon after the juveniles appeared full grown (4 weeks post fledging). The majority of juveniles (60%) seemed to disperse immediately before the subsequent breeding season while 16% stayed with parents in their natal territories. Sexual maturity occurred quicker than expected; both males and females can breed in the following year post-fledging, although only three individuals have been observed as breeders after dispersal. Female juveniles seem to disperse farther than males (400-700 m, <100 m respectively). Further data collection is ongoing to assess dispersal and recruitment in more detail.

Effects of landscape characteristics on diversity and abundance of migratory shorebirds in the Inner Gulf of Thailand

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The Inner Gulf of Thailand is known as an important stopover and wintering site for migratory shorebirds in the East Asian-Australasian flyway, but we lack basic ecological information about it and it currently has little legal protection. This study aims to investigate relationships between abundance of migratory shorebirds and surrounding landscapes and to define priority sites for conservation. Birds were counted during October 2006 – April 2007 at 20 sites along the Inner Gulf. Counts were performed four times at each site and the dependent double-observer approach was applied to calculate detection probability of each species in order to obtain more accurate estimates of abundance. There were 33 species recorded; the most abundant species were the Sand Plover, the Black-tailed Godwit and the Red-necked Stint, respectively. Two globally threatened species were found including the Spoon-billed Sandpiper and the Asian Dowitcher. The site with the highest abundance was Samut Sakorn Mangrove Research Station (23,122 birds) which also had the highest number of species (27 species). However, the Fisher alpha index indicated that Laem Pak Bia had the highest diversity (Fisher alpha = 3.85), which was assumed to be due to the greater evenness of species abundances. Cluster analysis was used to investigate community dissimilarities among the 20 sites by using the Bray-Curtis dissimilarity index as input. Sites clustered into four groups: poor, fair, good and high abundance sites. The detection probabilities have yet to be calculated for all species because larger samples of double-observer counts are needed. GIS analysis of bird communities in each site relative to landscape characteristics is on-going.

Pheasant habitat use and reproductive ecology in the Mo-Singto Long-term Biodiversity Research Plot, Khao Yai National Park

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In the last decade the population of the Siamese Fireback (Lophura diardi) has increased in our study site (about 850m elevation) whereas in the past only the Silver Pheasant (L. nycthemera) was known to be present. We started a long-term project to investigate the effect of this increasing sympatry, suggested to be the consequence of general forest structural changes in the region; changes that have triggered the movement to higher elevations of a typically lowland species. By working on color-banded and radio-collared birds of both species we first investigated the ranging pattern, habitat use, range overlaps and micro-habitat structural differences. We defined habitat by tree density (DBH $\geq$ 1 cm), soil moisture, canopy cover, elevation and slope exposure. Animal positions were recorded daily at two hour intervals. Locations were analyzed by ArcView GIS software using minimum convex polygons and kernel methods, and correlated with habitat variables. Home range size appeared to be 68 ha for the Siamese Fireback, which used primarily flat, wet areas, and 76 ha for the Silver Pheasant, which used more dry slopes. Second, we investigated their mating and nesting behaviour in order to define similarities that might, under extreme conditions, lead to inbreeding. Behavioural data were collected with 15-minute focal samplings in order to define bonding status between individual males and females and between males. Preliminary analyses suggest a difference between the two species' male mating strategies, with the Siamese Fireback showing a strong skew with a dominant male nearly monopolizing proximity with all females in the group. In the Silver Pheasant a lower skew was observed, with all males in the group sharing almost equal proximity with females. Mixed groups, with animals of both species, were sporadically observed.

Nightly activity patterns of understorey insectivorous bats in lowland tropical forest, Southern Thailand

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Activity patterns of understorey insectivorous bats in Ton Nga Chang Wildlife Sanctuary were investigated by setting overnight a time expansion bat detector. A total of 2,377 bat passes (series of calls) were recorded on 29 dark sample nights, with most of them being characterized by bats emitting constant frequency calls (1,851 bat passes, 78%) whereas the rest were characterized by bats emitting frequency modulated calls. Bat activity as revealed by echolocation calls were highest in the first two hours after sunset (14-15 bat passes/hour), and gradually declined throughout the night, and were lowest at dawn (1.3 bat passes/hour). Similarly, from 1,111 bat passes recorded on 15 light nights, the peak of activity was in the first three hours after sunset. On light nights, the second smaller peak of activity appeared to be at midnight. Fourteen species of bats emitting CF calls were recognised, 8 of which were tentatively identified to species. They are *Rhinolophus lepidus*, *R. stheno*, *R. affinis, R. robinsoni, R. macrotis, R. trifoliatus*, *R. coelophyllus*, and *Hipposideros larvatus*. Among these, *R. trifoliatus* had the highest number of bat passes (1,004), followed by *R. affinis*, *R. macrotis*, and *R. lepidus* (74-289 bat passes).

Population census and cave re-location investigation of the Thailand roundleaf bat (*Hipposideros halophyllus*), a Thai endemic mammal

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Hipposideros halophyllus was categorized by the IUCN in 1994 as being in the LOWER RISK, Near Threatened subcategory (LR/nt). The current global status is likely underestimated and unsupported by sufficient information because biological and ecological data on the bat has never been documented since its first discovery from 33 years ago until 2006. The most recent numbers estimated for the bat population were approximately 1,400 individuals across the country, which is possibly classified in the ENDANGERED (EN) category (criteria C) of the 2001 IUCN Red List Categories and Criteria version 3.1. However, current estimates of population size were likely biased because of geographic limitations in searching for their roosting sites, and poor visual observation in caves. Our objectives are to efficiently examine roosting caves, and to accurately estimate the population size. We determined roosting caves using a bat detector, and evaluated the number of populations using capture-recapture techniques. The first field work was conducted during 10-16 June 2007 at Khao Samo Khon, Lop Buri province. The ultrasonic calls of the bats ranged between 173 – 191 kHz. We discovered six roosting caves and were successful in capturing and marking 40 adult males and 39 post lactating females from three caves. We also captured a bat, with the circular-cut hole on the wing membrane made during marking, from a new roosting site, Fachi cave, the next day. There was no evidence to indicate its original cave because the bat cleaned the hair-dye marks from its back and color marks from its forearm.

Population, distribution and participatory conservation of the White-handed gibbon (*Hylobates lar* L.) in Mae Hong Son province, northern Thailand

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White-handed gibbons (*Hylobates lar*) in Mae Hong Son are critically endangered. There are about 293 individuals in 66 groups within 33 isolated locations based on interview, survey and direct observation in 53 villages. Population sizes within a locality are 1-30 individuals. They are all facing extinction in the area. Local wisdom of 2 ethnic groups (Karen and Lahu Na) is very important for gibbon conservation. Socialization using traditional knowledge within ethnic groups has been eroding and has not been connected with the education system. The traditions and beliefs of Sgaw Karen communities and some impassioned individuals have helped the remaining gibbon populations. Major threats are hunting for food, and field crop expansion performed by various ethnic groups especially Lisu, Hmong and Lahu. Uncontrolled forest exploitation and growing urbanization cause habitat destruction and isolation. Community empowerment, impassioned individuals and place-based education are needed to promote gibbon conservation in these areas.

Preliminary results on distribution, ecology and behaviour of the pigtail macaque (*Macaca nemestrina*) in Khao Yai National Park

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Pigtail macaque (*Macaca nemestrina*) ecology and behavior is still largely unknown. We started a long term project in 2006 to investigate the socio-ecology of two semi-habituated troops in Khao Yai National Park, Thailand. We observed activity budgets, feeding ecology, home ranges and seed dispersal capacity of two semi-habituated troops (HQ and CAM). Data were collected with 30-min scan sampling alternated with 10-min focal sampling of mature males. Scan sampling included records on habitat type, individual identification, age/sex class, canopy height used, attention status, behavior (activity and social interactions, specifying donors/receivers). Eaten items (species, part consumed, and maturity) were also recorded. During contacts with the macaques, we recorded GPS coordinates every 30 minutes. A home range size of about 1 km^2 was estimated for the HQ troop with a daily distance traveled of 2600 meters (SD+/- 250m). For the CAM troop the home range size was estimated at 3.2 km^2, with daily distance traveled being about 4500 meters (SD+/- 250m). Preliminary analysis of habitat use shows that macaques tend to spend most of the early morning and late afternoon in close proximity to human settlements while the middle of the day is spent in the pristine forest. Data collected on fruit species consumed by macaques and germination enhancement of dispersed seeds showed an overall consumption of 50 plant species of which 15 were dispersed.

Effects of planted trees and the bird community on natural seedling recruitment in a forest restoration area using the framework tree species method

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Forest restoration by planted trees can attract birds and mammals, which can accelerate recovery of biodiversity by dispersing seeds from natural forest into planted sites. This research is examining the attractiveness of different "framework tree species" in a forest restoration site established by the Forest Restoration Research Unit (FORRU), at Ban Mae Sa-Mai, Mae Rim District, Chiang Mai. Natural tree seedlings have been surveyed beneath 5 species of framework trees: *Erythrina subumbrans*, *Hovenia dulcis*, *Melia toosenden*, *Prunus cerasoides* and *Spondias axillaris*. Five individual trees of each species were selected (25 trees) in 3 replicated plots of the same age (9 years since planting). Bird observations were carried out on each tree to determine bird communities, which are assumed to affect natural seedling recruitment. A total of 37 tree seedling species were found beneath the trees, of which 11 species were wind-dispersed and 26 species animal-dispersed. *Prunus cerasoides* supported the highest density of tree seedlings, whilst *Hovenia dulcis* supported the lowest. Forty-eight bird species were recorded using the trees, of which 23 species were frugivores and 22 species non-frugivores. *Prunus cerasoides* supported the highest density and species richness of birds, whilst *Hovenia dulcis* supported the lowest. Different tree species characteristic such as tree size (GBH), height and crown width affect seedling recruitment. The effects of bird communities on seedling recruitment are different among the trees. Bigger trees, which attract high numbers of birds by providing food resources and perching sites may increase seed dispersal into the plots more than smaller trees.

Natural establishment of tree seedlings in forest restoration trials at Ban Mae Sa Mai, Chiang Mai Province

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Chiang Mai University's Forest Restoration Research Unit has successfully adapted the framework species method of forest restoration to accelerate natural regeneration of upland evergreen forest on deforested sites in northern Thailand. The method involves planting 20-30 indigenous forest tree species selected for fast growth, resilience to weeds and fire, and attractiveness to seed-dispersing animals. Trial plots to test the technique have been established annually in Doi Suthep-Pui National Park, northern Thailand, since 1998. The objectives of the research presented here were i) to determine to what extent the framework species method encourages recruitment of non-planted tree species into planted plots, resulting in increased tree species richness and a return to the tree species composition of natural forest, and ii) to determine the effects of the planted tree species, planting plot-age and fire on natural tree seedling establishment. Circular sample units of 10 m in diameter were laid out across plots planted in 1998 (9 years old) and 2002 (5 years old) and non-planted control plots. The results showed that seeds of most tree species were dispersed into the planted plots by animals (rather than by wind). Seedling numbers increased with the plot-ages. The mortality of seedlings in the control sites was mostly 3 times higher than in the planted plots. Moreover, 73 percent of the total number of tree seedlings established in the planted plots were recruited species (non-planted species). Therefore, the framework species method is effective at accelerating forest regeneration.


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จุลินทรีย์

Biodiversity of waste lubricating oil-degrading bacteria in soil

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Waste or used lubricating oils have become a serious environmental problem. Once in the environment, waste oil can bind to organic matter, mineral particles and organisms. This can play an important role in the persistence and toxicity of oil components. Hydrocarbon assimilation, however, can be conducted using many methods. Bioremediation is a promising method because it is effective, is of lower cost than other technologies, and the final products are water and carbon dioxide. Hydrocarbon microbiology research has supported the hypothesis that hydrocarbons and its derivatives are amenable to microbial degradation; microorganisms possessing this potential are widespread in many environments. The ability of microbial communities to adapt to contaminants is evident from contaminated zones. Accordingly there is a good possibility to use bioremediation to eliminate spilled oil or waste lubricating oil in the environment. Therefore, this research aims to isolate and screen waste lubricating oil-degrading bacteria from soil. Bacterial strains which exhibit high degradation activity will be selected and identified, and the selected strains will be kept for use in the future.

Biodiversity of marine gliding bacteria in Thailand

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This investigation of marine gliding bacterial diversity in Thailand has led to the discovery of at least 2 new genera and 3 novel species based on the analysis of 16s rDNA sequences and the biochemical characteristics of the isolates. The newly proposed taxa include *Aureispira marina* gen. nov. sp. nov., *Aureispira maritima* gen. nov. sp. nov. and *Rapidithrix thailandica* gen. nov. sp. nov. The remaining unidentified isolates have 16s rDNA sequences close to *Cytophaga* sp. and alpha-proteobacteria but the percentages of similarity are lower than 95, suggesting that these can be also classified as novel genera or species. Identification of these isolates is currently being investigated.

Pyrrole derivatives from a marine gliding bacterium

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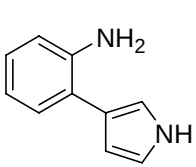
A methanolic extract of *Rapidithrix thailandica* TISTR1749 showed anticandida activity at 150 mg/mL with low cytotoxicity (against cancer cell lines not higher than 15% at 25 μg/mL). Further investigation led to the isolation of a new pyrrole derivative, 3-(2′-aminophenyl)-pyrrole **(1)**, along with its isolation artifact, 2,2-dimethyl-pyrrolo(1,2)-dihydroquinoline **(2)**. The isolation and structural elucidation of both compounds will be presented.



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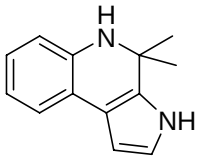

2

Numerical analysis and random amplified polymorphic DNA (RAPD) analysis of root-nodule bacteria isolated from the Thai medicinal plants, *Pueraria mirifica, Derris elliptica* Benth., and *Indigofera tinctoria* Linn.

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Root-nodule bacteria were isolated from some Thai medicinal plants, including *Pueraria mirifica, Derris elliptica* Benth., and *Indigofera tinctoria* Linn, growing in 16 provinces in Thailand. The 221 isolates were analyzed for DNA polymorphisms using a randomly amplified polymorphic DNA (RAPD) method. The results indicated that there was significant genetic diversity among strains from distinct geographical areas. A total of 54 representative strains were characterized by a numerical analysis of 113 phenotypic features including utilization of 50 carbon sources, utilization of 30 nitrogen sources, requirements for 10 vitamins, tolerance to 10 antibiotics, growth at pH 5.5, 6.5 and 8.0, growth on media supplemented with NaCl at concentrations of 0.2 and 1.0 M, growth at 20, 30, and 40°C, acid or alkaline production, colony morphology, doubling time, indole-3-acetic acid (IAA) production and melanin production. The strains could be differentiated and the phenotypic diversity among these strains was revealed.

Quality of bacterial strains after collection by the freezing method

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Bacterial strains are well recognized for their extremely wide applications. One of the most important processes supporting the sustainable uses of all microorganisms is to maintain all those useful strains in the form of culture collections with high stability and good quality. The objective of this work is to evaluate the stability and quality of some medically important bacterial strains after they have been maintained in a culture collection for 2-12 years. A total of 300 strains of 15 bacterial species were analyzed for their quality according to their viability, purity, phenotypic characters and genotypic characters after a period of collection ranging from 2 to 12 years. The results showed a mean viability of about 5-11 log10 CFU/ml that was not significantly different among species except for some fastidious bacteria such as *S. pneumoniae* and *H. influenzae*, in which viabilities of from 5-7 log10 CFU/ml were observed. All cultures were pure with phenotypic characters corresponding to the typical characters of each. Genotypic characters were investigated using the PCR-RFLP technique with a universal primer pair to amplify a portion of the 16S rRNA gene, followed by restriction analysis of the PCR products. The results also exhibited good genotypic quality. It can be concluded that all bacterial strains are in good condition for any potential uses.

Phylogenetic analyses of Ingoldian anamorphs in the genus *Hymenoscyphus*

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Evolutionary trees based on 18S rDNA (or SSU) and ITS1-5.8S-ITS2 sequences were generated by using Neighbor-Joining (NJ), Maximum Parsimony (MP) and Maximum Likelihood (ML) analyses to clarify the anamorph-teleomorph connections in 69 taxa including both in-group and out-group taxa using fungal reference species from GenBank. Molecular phylogenies clustered the chosen taxa and their related fungi into the classes Dothideomycettes, Leotiomycetes and Mitosporic Ascomycota. The NJ tree showed similar topology to the trees obtained by MP and ML analyses. The separation of the Class Dothideomycettes from the Class Leotiomycetes in the trees is well supported by bootstrap values. *Beltrania rhombica* (SS 3562), *Speriopsis pedatospora* (SS 2236), *S. pedatospora* (SS 2229) and *Brachiosperia tropicalis* (SS 2152.1) were clustered in the Dothideomycetes whereas *Variocladium giganteum* (SS 3012), *Cudoniella indica* (SS 708), *Varicosporium delicatum* SS3008, *Tricladium terestre* (SS 3011), H*ymenoscyphus varicosporoides* (SS 76.01) and *Cudoniella indica* (SS 3005) were grouped in the Leotiomycetes.

Diversity and distribution of freshwater fungi in natural habitats with different temperatures in Thailand

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One-hundred and forty-seven species of freshwater fungi were collected from the south and east of Thailand in a range of water temperatures between 25 and 63°C. Two-hundred and nine strains were isolated and preserved in the BIOTEC Culture Collection (BCC). These included 63 Ascomycetes (43% of total taxa) and 79 Mitosporic fungi (54%). They belonged to 2 classes, 8 orders, 13 families and 42 genera. Sirindhorn Waterfall (25°C) at Hala-Bala National Park possessed the highest fungal diversity (60%) while Saphan Yung Hot-stream (43°C) and Khuankhang Hot-springs (51°C) had the lowest (4%), with 0% at Marine Hot-springs (45°C) and Wat Than Nam Ron (63°C). This study showed that the number of fungal species is not correlated to the temperature of the habitat where fungi were found. The reason may be due to the thermo-tolerance characteristics of freshwater fungi. Moreover, water from Marine Hot-springs and Wat Than Nam Ron, which is based on powdery sand rock with salt and $CaCO_3$ crystal accumulations, may influence the efficiency of fungal growth and colonization of substrata. The most common species in streams with normal temperature profiles (e.g. <35°C) were *Ellisembia opaca*, *Phaeoisaria clematidis* and *Sporoschisma uniseptatum*. *Monodictys* sp.1 was recorded from both normal temperature streams and hot-spring habitats. However, our study requires more information before conclusions concerning the relationship between temperature and freshwater fungal biodiversity can be made.

Palmicolous fungi in Thailand

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The biodiversity of fungi on selected palms, *Calamus* sp. and *Elaeis guineensis*, was studied. One field collection of endophytic fungi was made in November. Ten field collections were made for saprophytic fungi in September, October, November, and December 2006, and March 2007, and one for endophytic isolation experiments (November 2006). Saprophytic fungi on *Elaeis guineensis* comprised a total of 65 taxa: 28 Ascomycota, 28 anamorphic fungi and 9 Basidiomycota. *Annulatascus velatispora*, *Stilbohypoxylon* sp., *Falciformispora* sp. and *Vanakripa* sp., *Grammothele fuligo*, *Schizophyllum commune* and *Marasmius* sp. were common on this palm. On *Calamus* sp., a total of 98 taxa (224 records) were found: 40 Ascomycota, 12 Basidiomycota and 46 anamorphic fungi. Samples were collected from 4 parts of the palm with 61% of the fungi recorded from petioles, 38% from rachises and 1% from trunks. Palm material collected from different habitats was also sampled. Dry aerial material yielded 68.5% of the fungi and damp/moist material 31.5%. On this palm, a number of species, AOM 318, *Morenoina palmicola* and *Circinoconis paradoxa*, were common. Endophytic fungi within petioles and leaves of the oil palm, *Elaeis guineensis*, from an oil palm plantation in Trang Province were sampled. One thousand and seventy-two isolates were made. Cultures on PDA and CMA were examined periodically for reproductive structures and identified as they sporulated. Many cultures did not sporulate but their distinctive colony morphology and production of sterile stromata, suggested they were xylariaceous species, with 54 morpho types. Two hundred and eighty-seven axenic morpho strains were characterised and deposited in the BIOTEC Culture Collection (BCC).

Morphological and molecular characteristics of a poorly known marine ascomycete, *Manglicola guatemalensis* (Jahnulales: Pezizomycotina; Dothideomycetes, *Incertae sedis*): A new lineage of marine ascomycetes

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Collections of the poorly known marine ascomycete *Manglicola guatemalensis* from Trang and Trat Provinces, Thailand, were made in 2005 and 2006 from the brackish water palm *Nypa fruticans*. This fungus is only known from two previous collections. This paper reports on the morphological characteristics and molecular phylogeny of this unique marine bitunicate ascomycete. *Manglicola guatemalensis* has large clavate to obtusely fusiform ascomata, wide ostioles, bitunicate asci, cylindrical, thick-walled, unequally one-septate ascospores, constricted at the septum, apical cell larger, chestnut-brown and a smaller light brown basal cell. Ascospores germinate readily, always from the basal cell. Four isolates from different locations were selected for the phylogenetic study. Different regions of the rDNA gene, including SSU and LSU, were sequenced. The molecular data places *M. guatemalensis* in the Jahnulales with high bootstrap support, all strains are monophyletic. In the combined SSU and LSU analyses the Jahnulales comprise two subclades, A and B. In subclade A, *Manglicola* strains form a sister group to the *Jahnula* species, *Jahnula appendiculata*, *J. australiensis*, *J. bipolaris* and *J. sunyatsenii*. Subclade B comprises *A. khaoyaiensis*, *J. siamensiae* and *Patescospora separans.*

Putative basidiomycete teleomorphs and phylogenetic placement of the coelomycete genera *Chaetospermum*, *Giulia* and *Mycotribulus* based on nuclear rDNA sequences

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Few basidiomycetes are known to have a coelomycete anamorph. The partial small subunit and large subunit of nuclear rDNA of three coelomycete genera (*Chaetospermum*, *Giulia*, *Mycotribulus*) were sequenced to determine their phylogenetic relationships. *Mycotribulus mirabilis* was well placed in the marasmioid clade (Marasmiaceae and Physalacriaceae), Agaricales, while *Giulia tenuis* clustered with the Corticiaceae, Corticiales. *Chaetospermum camelliae* and *Chaetospermum artocarpi* formed a close relationship with the Sebacinaceae, Sebacinales. Although morphologically these coelomycetes are pycnidial and with appendaged conidia, they show no consistency in their phylogenetic relationships, belonging to disparate major taxonomic groups with putative teleomorphs in the Agaricales, Corticiales and Sebaciniales. Further molecular studies of coelomycetes may be rewarding to evaluate their phylogenetic affinities.

Diversity of Thai Coelomycetes

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Coelomycetes are anamorphic fungi that produce asexual spores (conidia) within a flask-shaped (pycnidium) or a shield-shaped structure (pycnothyrium), or by a combination of fungus and host tissue (acervulus), or on a mass of vegetative mycelium (stromata). They play important roles in terrestrial ecosystem functioning as decomposers, endophytes, and parasites. Previous studies of Thai coelomycetes have focused on pathogenic taxa of agricultural importance with *Colletotrichum* species being dominant. The objectives of this study were to extend our knowledge of this fungal group to the colonization of substrata in non-agricultural ecosystems and to isolate them into axenic culture for further utilization. Incubation and examination of fallen leaves, dead twigs, decaying fruits and seeds collected from various natural forests and urban parks have yielded over forty coelomycete species. *Chaetospermum camelliae* was the most abundant species and common to a wide range of habitats. The other frequent species included *Coniella castaneicola*, *Pseudorobillarda sojae*, *Satchmopsis brasiliensis* and various *Pestalotiopsis* species. Ecological study has focused on the coelomycete communities in two forest types of Khao Yai National Park, an evergreen forest and hill evergreen forest, and in an urban park of Bangkok. The results have shown that the urban park possessed the highest species richness while the evergreen forest possessed the highest species diversity and offered some new taxa. Similarities of coelomycetes between the two natural forests were higher than those between the natural forest and the urban park.

Fungal communities on decaying seeds of the Dipterocarpaceae

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Fungi on naturally decaying seeds play an important role in recycling nutrients in the forest ecosystem. They have also shown ability in producing bioactive compounds with pharmaceutical potential. Trees of the family Dipterocarpaceae are of ecological and economic significance. They predominate over a wide area of tropical forest in Asia. A study on fungi colonizing seeds of this family is therefore proposed in order to obtain ecological information on fungi in relation to the major trees of the tropical forest, and to isolate these fungi into axenic culture. Any new fungi collected during the study will be described and published. Cultures isolated from this study will support further biotechnological utilization whereas data on fungal ecology will contribute basic knowledge for natural resource management in this country.

A preliminary study on termite-associated *Xylaria* in Thailand

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The *Xylaria* species associated with termite nests are poorly known. It has been a common belief that all belong to three or four species. It is now known that a wide range of species are involved but many species appear to be undescribed. This project is a preliminary project with the aim to study fungi associated with termite nests and to study the biodiversity of Xylariaceous fungi in Thailand, especially *Xylaria* species, in order to fully understand the diversity of this group of taxa. Previous surveys and collections have resulted in more than 10 variable morphological characters being found. Molecular results show there are three separate clades of *Xylaria* species associated with termite nests.

Aquatic fungi developing on eggs of tilapia, *Oreochromis niloticus* Linn., and their control

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Fungal-infected eggs of tilapia (*Oreochromis niloticus* Linn.) were collected from Kalasin, Khon Kaen, Maha Sarakham and Sakon Nakhon Provinces during June 2005-April 2006. The fungi were identified to the family Saproegniaceae (*Achlya* spp., *A. ambisexualis*, *A. bisexualis*, *Aphanomyces* spp., *Saprolegnia diclina*) and family Pythiaceae (*Pythium* sp.). Some biological characteristic studies were conducted. The optimal temperatures for vegetative growth of *Achlya*, *Aphanomyces*, *Saprolegnia* and *Pythium* were 20-35 ºC, whereas the optimal temperature for zoospore production was 25 ºC. The optimum pH for vegetative growth and zoospore germination of all genera were 6.0-9.0 and 4.0-11.0, respectively. Histopathological examination of fungal-infected eggs showed numerous hyphae spread over the outer layers of egg envelopes and penetrating egg envelopes. The anti-fungal effect of sodium chloride on zoosporic and vegetative stages was 2.5 and 3.0 % exposed for 2 and 24 hours, respectively, whereas 25 and 200 µg/mL potassium permanganate was effective in killing the zoosporic stage at 30 minutes and the vegetative stage at 24 hours, respectively. Toxicity of 2.0 % sodium chloride or higher reduced the percent hatching rate of treated groups of eyed eggs ($P<0.05$). Treatment of eyed eggs with 25, 50, 100, 150 and 200 µg/mL potassium permanganate against fungal activity showed 0 % hatching rate within 1 and 24 hours exposure. Therefore, it may be possible to use 3.0 % sodium chloride or higher concentrations to prevent fungal infection of tilapia eggs by bathing with less than 1 hour exposure.

Biodiversity of water moulds in water and fungal infection in fish in the Chi River

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Isolation of water moulds from water and fish in the Chi River in Chaiyaphum, Khon Kean and Mahasarakham Provinces was conducted during April to June 2007. Fungi were mostly isolated from water; in total there were 48 strains. Only 2 were isolated from diseased fish because fungal infection was lacking due to high temperatures (31-34°C). Isolated fungi were classified as Class Oomycetes and most belonged to the Order Saprolegniales, Family Saprolegniaceae. In this family, the Genus *Achlya* obtained from the study sites was dominant. Other genera, such as *Saprolegnia* and *Aphanomyces* and *Leptolegnia*, were also found as well as several isolates of imperfect fungi, which have not been identified yet. Moreover, some unidentified strains of Oomycetes were not characterized yet because neither asexual or sexual reproduction has occurred. However, the results indicated that geographical differences, rather than infected fish species have played an important role in the species diversity of water moulds. In further study, fungal collection and biological characteristics as well as molecular characteristics based on internal transcribed spacer genes will be determined to evaluate fungal evolution and construct phylogenetics. In addition, determination of pathogenicity capacity of the fungi to snakehead and nile telapia, histopathological examination of diseased fish and the development of prophylactic and curative fungicides for the isolated fungi will be carried out.

Species diversity of antagonistic fungi, *Trichoderma* spp., in tomato seed production fields and their application for biological control of plant diseases

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One hundred and eighty-six isolates of soil fungi derived from tomato and cucurbit seed production fields in Khon Kaen and Maha Sarakam provinces were tested for antagonistic properties against the Fusarium wilt pathogens, *Fusarium oxysporum* f.sp. *lycopersici* (FOL), *F. oxysporum* f.sp. *melonis* (FOM) and *F. oxysporum* f.sp. *cucumerinum* (FOC). Sixty-two isolates were effective against FOL, 28 against FOM and 20 against FOC. Twenty isolates were classified in the genus *Trichoderma* and coincidently showed antagonistic properties against all wilt pathogens. Based on morphological characteristics, *Trichoderma* spp. were identified as *Trichoderma harzianum*, *T. koningii*, *T. piluliferum*, *T. aureoviride* and *T. reesei* for 5, 10, 1, 3 and 1 isolate, respectively. The *T. aureoviride* (TKK2701) and *T. koningii* (TKK4301) showed higher cellulolytic activities than other isolates. The *T. aureoviride* (TKK2701), *T. koningii* (TKK2602, TKK4301, TKK2203), and *T. harzianum* (TKK3803) isolates expressed high protease activity. Chitinolytic activity was detectable for most isolates except *T. koningii* (TKK3702) and *T. harzianum* (TKK3803). However, *T. harzianum* (TKK2801), *T. aureoviride* (TKK1001) and *T. koningii* (TKK3501) produced high activity of β-1,3 glucanase. The results of fungicide tests revealed that all isolates of fungi were tolerant toward carboxin, captan, and slightly tolerant to mancozeb. However, there was sensitivity to carbendazim. The high potential isolates for integrated use with fungicides for control of wilt of tomatoes and cucurbits were *T. aureoviride* (TKK1001), *T. harzianum* (TKK2501), and *T. koningii* (TKK2602, TKK3501, TKK4701). This study showed the species diversity of antagonistic fungi, *Trichoderma* spp., in vegetable seed production fields for export, their potential and their integrated use for control of Fusarium wilt of tomatoes and cucurbits.

A Study of microorganisms involved in organic fertilizer production processes at the biofertilizer plant of Takam Subdistrict Administration Organization, Hat Yai District, Songkla Province

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This study aims to compare enumeration methods for microorganisms involved in organic fertilizer production processes at the biofertilizer plant at Takam Subdistrict Administration Organization, Hat Yai district, Songkla province. A culture-dependent method and 16S rDNA clone library analysis technique were used. The results of the culture-dependent method showed that numbers of microorganisms varied among different production processes. Most mesophilic microorganisms were found to be dominant groups in raw material mixtures. 16S rDNA clone library analysis was conducted on microorganisms from the raw material mixture and the finished fertilizer product. Three clone libraries were studied, two clones for bacterial communities and one for actinomycetes. The results showed that halophilic bacteria (such as *Salinicoccuss*, *Salinicoccus*) were the most dominant group consisting of 93% and 61% of total bacterial clones in the raw material mixture sample and the finished fertilizer product, respectively. *Dietzia* in the actinomycetes clone library (71% of total clones) was the dominant group. Some uncultured bacteria were also found in all clone libraries which had not been obtained by the culture-dependent method.

สาหร่าย และแพลงก์ตอน

Diversity of halophilic cyanobacteria in saline areas in some regions of Thailand

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The halophilic cyanobacteria are a group of cyanobacteria that can grow in high salt concentration biotopes. They can tolerate this situation because they can maintain the level of osmotic pressure between their cells and their environment. The objectives of this research concern the biodiversity and distribution of halophilic cyanobacteria including some physical and chemical characteristic of their habitats. A preliminary study in the northeastern parts of Thailand in March 2007 found 3 divisions, i.e., Cyanophytes, Chlorophytes and Chrysophytes. Dominant species are in the Division Cyanophytes and are *Chroococcus* sp., *Osillatoria* spp., and *Phormidium* sp., and include the diatom, *Amphora* sp. Cultures of these algae are in progress.

Genetic diversity and phylogenetic relationships of hot spring cyanobacteria

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Short and long tandemly repeated repetitive sequences (STRR and LTRR) of 11 hot spring cyanobacteria were studied. Cyanobacterial isolates were selected from culture collections maintained at the Applied Algal Research Laboratory CMU representing different morphogenera or morphospecies. DNA fingerprinting was obtained following PCR reaction using primers specific to tandemly repeated repetitive sequences. Two primers, STRR 1A and STRR 1B, specific to short tandem repeats, were successfully used to generate fingerprints, while primers specific to long tandem repeats were not. Fingerprints from both primers generated congruent trees with two main clusters. However, clusters were not in agreement with taxonomic groups; only three strains in the genus *Synechococcus* formed a subgroup together within Cluster I. Further analysis of sequences of *cpc*-IGS and rDNA-ITS of these strains will be conducted to confirm relationships within this group of cyanobacteria.

Research and development of algal products for restoration of soil and sustainable production of agricultural products

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Algae, the microorganism group that produces extracellular polysaccharide substances (EPSs), play a significant role in soil aggregation, soil structure and stabilization. Therefore, algae either as living biomass or secreted in EPSs form can be used as soil biofertilizer/conditioners to improve soil structure and increase soil organic matter. Twenty-eight blue-green algal strains from the Algal Culture Collection at MIRCEN, TISTR, were studied for their growth and polysaccharide production. The experimental results indicated that all 28 algal strains produced variable amounts of total polysaccharide. Among these, 4 algal strains that had high total polysaccharide contents with rapid growth, namely *Nostoc* sp. TISTR 8290, *Nostoc muscorum* TISTR 9054, *Nostoc muscorum* TISTR 8871, and *Nostoc* sp. TISTR 8873, were selected. These 4 algal strains had total polysaccharide contents of 124.86±2.74, 120.10±2.56, 117.94±1.65, and 114.92±2.00 milligrams per gram of dry algae, respectively. Living biomasses produced by these 4 algal strains were 29.07±1.13, 14.63±1.39, 16.06±1.61, and 33.08±1.56 grams per litre, respectively. Further study on the effectiveness of *Nostoc muscorum* TISTR 9054 for the improvement of plant growth (*Oryza sativa* L. Pathumthani 1) and soil properties (Din Lumduan) was conducted in a pot experiment. Height of rice seedlings grown in soil mixed with algae (10:1, w/w) for 35 days of cultivation was 35.88±0.67 cm which was significantly different ($p=0.02$) to shoot height of rice seedlings in the control (32.82±0.87 cm). Analytical results for organic matter (OM) content and water holding capacity (WHC) showed that %OM in soil mixed with algae increased from 9.60% to 199.97% while %WHC also increased from 132.74% to 235.18%. This indicated that soil properties could be improved by the addition of algae.

Characterization of soil conditioners from algae

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The efficiency of soil conditioners from algae was studied by comparison between the addition of algal biomass (AB) and extracellular polysaccharide (EPS) to two types of soil, i.e., 1) paddy soil of Thung Gula Ronghai in Roi Et province, and 2) garden soil of Lam Takhong Research Station in Nakhon Ratchasima province. Four *Nostoc* strains (TISTR 8290, 8871, 8873, and 9054) which had been previously screened and selected as potential strains based on their rapid growth and high EPS production were applied. The experiments were conducted using a Completely Randomized Experimental Design (CRD) with 3 replicates for each treatment. Plastic boxes (13x13x4.5 cm) containing 250 g of soil were used. For the AB model, 10 g of fresh AB were spread over the soil surface and kept under cool-white fluorescent lamps at a light intensity of 60 $\mu E/m^2/s$. In the case of the EPS model, 32 ml of EPS were spread over the soil surface and kept in the dark. All test boxes were covered with plastic lids to control soil moisture and were incubated at 28 ± 1^oC for 2 months. Findings indicated that *Nostoc muscorum* TISTR 9054 delivered the best results in either soil with the addition of AB or EPS. These results showed statistically significant differences ($p\leq0.05$) to the control group in terms of organic compounds, microbial activity, soil bulk density and soil bulk porosity of Lam Takhong soil and organic compounds and microbial activity of Thung Gula Ronghai soil. The stability of soil against water action is in the process of analysis.

Screening for herbicide-production by microalgal strains

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The purpose of this study was to screen algal strains for effective production of herbicidal compounds. The crude extracts of three algal strains, *Anabaena* sp. TISTR 8077, *Hapalosiphon fontinalis* TISTR 8225 and *Oscillatoria* sp. TISTR 8245, were assayed for their inhibition effects on the growth of rice seedlings (*Oryza sativa* L., Pathumthani 1) at the MIRCEN laboratory, TISTR. The highest efficiency was found for the crude extract of *Hapalosiphon fontinalis* TISTR 8225 at concentrations of 0.15-12.0 g DW L^{-1}(80% MeOH) which exhibited inhibition effects on the shoots and roots of rice seedlings at 24-35% and 56-82%, respectively. The phytotoxicity of the crude extracts of all algal strains to root growth was greater than that to shoot growth and the inhibition effect was dependent on the concentration. The lowest EC_{50} (50% effective concentration) obtained from crude extracts of *Hapalosiphon fontinalis* TISTR 8225 on shoots and roots were 17.2 and 2.6 g DW L^{-1}, respectively. The results indicated that crude extracts of *Hapalosiphon fontinalis* TISTR 8225 using MeOH at 40°C in the dark (R^2 = 0.9004) could greatly inhibit the growth of roots. Furthermore, SEM and TEM observations showed that the external layers and the cells of root tips were destroyed. It is suggested that the crude extract of *Hapalosiphon fontinalis* TISTR 8225 could be used as a substance for developing natural herbicides, particularly for the inhibition of root growth of some grasses.

A comparative study on morphology of the Agarophyte, *Gracilaria salicornia* (C. Agardh) Dawson, occurring along the North Coast of the Gulf of Thailand

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Specimens of *G. salicornia* were randomly collected from 11 sites in five provinces at Chonburi (Ko Sichang, Ang-Sila, Sri Racha harbour, Samaesan), Rayong (Ban phe), Trat (Laem sok, Laem Thien, Ao cho), Prachuap Kiri Khan (Ta Monglai, Wanakon beach) and Chumporn (Thung Wua Laen beach), during low tide in the dry and monsoon seasons. The collected samples were preserved in formalin solution. Specimens were also dried on herbarium sheets. Changes in morphology of the specimens were examined with reference to different habitats. Collected specimens showed variation in external features in relation to season and habitat and could be divided into two groups. Group I fronds were cylindrical, constricted and with articulated branches. These characters were found in specimens from Ko Sichang (Ø 0.90-1.95 mm) and Ang-Sila (Ø 0.80-1.90 mm). In Group II, fronds were succulent forming slightly articulated branches or constricted articulated branches as above. These characters were found in specimens from Sri Racha harbor (Ø 2.20-3.85 mm), Samaesan (Ø 1.30-2.85 mm), Ban phe (Ø 1.20- 3.20 mm), Laem Sok (Ø 1.80-3.35 mm), Laem Thien (Ø 2.25-3.80 mm), Ao Cho (Ø 1.50-3.85 mm), Ta Monglai (Ø 2.05-3.75 mm), Wanakon beach (Ø 0.95-3.75 mm), and Thung Wua Laen beach (Ø 1.80-3.70 mm). Group I showed no significant difference in segment diameter ($p = 0.05$) among specimens, while Group II showed variation in morphology with habitat. There were no significant differences in segment diameter with season except for plants collected from Ang-Sila, Ban phe, Wanakon beach and Thung Wua Laen beach.

Yield, composition and antimicrobial activity of polysaccharide extracted from brown seaweed by hot water extraction

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Seven species of brown seaweed, namely *Colpomenia sinuosa*, *Hydroclathrus clathratus*, *Sargassum polycystum*, *Turbinaria conoides*, *Dictyota dichotoma*, *Padina australis* and *Padina minor*, were collected from Chonburi, Rayong and Chumporn provinces. Samples collected were dried at room temperature and extracted in distilled water at 100 °C for 2 hrs. Yield of the extracts had maximum values of 2.98% in *P. australis* and 2.86% in *S. polycystum* collected from Rayong province. The lowest yield of 1.4% was obtained from *D. dichotoma* collected from Chumporn province. Total carbohydrate contents were highest in the extracts of *P. minor* (56.31%) and *P. australis* (51.54%) while the lowest value of 32.17% was obtained from *T. conoides*. The highest sulfate content was 18.38% obtained from the extract of *H. clathratus* while the lowest contents were 4.93% and 4.92% in *P. australis* and *S. polycystum,* respectively, collected from Chonburi province. Components of monosugar in the extracts were analyzed by the TLC technique using glucose, galactose, fucose, mannose and fructose as standard references. The TLC analysis showed fructose sugar as an essential component in all extract polymers. The antibacterial activity of the extracts was screened using the bacterial species, *Vibrio parahaemolyticus* and *V. haveyi*. *Padina australis* collected from Rayong showed inhibition to *V. parahaemolyticus* at all concentrations of 100, 250, 500 ppm. The most effective inhibition (1.52 ± 0.13 mm) was obtained from the extract concentration of 500 ppm while inhibition at concentrations of 100 and 250 ppm were 1.07 ± 0.16 mm and 1.30 ± 0.05 mm, respectively.

Population structure of *Padina australis* Hauck (Dictyotales, Phaeophyta) in two locations in Phuket Province, Thailand

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The genus *Padina*, a brown alga (Phaeophyta), has a worldwide distribution in tropical and subtropical climate zones. Because of the broad distribution of this genus, we posed the question: How does *Padina* increase the number of individuals and what factors support its reproduction? The purpose of this project is to study the population structure of *Padina australis* Hauck in two locations on Koh Phuket. The hypothesis includes the idea that characteristic patterns of growth, reproductive cell formation and recruitment in the natural habitats will determine the distribution of particular phases of the life history, the numbers of each phase and the annual cycle of growth, maturation, death and then recruitment of new individuals. The two populations at the contrasting habitats of Sirinart National Park (SNP) and Tang Khen Bay (TKB), undoubtedly show similarities and differences over the year of study. Thirty samples have been collected at 20 meter intervals from the shoreline in the intertidal zones. The length, radius, maturity phase, quantity of reproductive cells and quantity of released reproductive cells were recorded for each individual. The recruitment study was carried out on hard substrata *in situ.* Three permanent plots 0.25 m^2 were studied every 20 meters. Intraspecific competition was calculated from percentage of recruitment at the two sites. The research started in September 2005 and it will be finished in August 2006. The results showed significant differences in population distribution, reproductive potential and recruitment success ($P \leq 0.5$). The factor that differentially influenced *P. australis* populations at the two sites was mainly wave currents which had a strong influence on *P. australis* at SNP.

Seasonal variation in distribution, density, and life stage of *Halimeda macroloba* Decaisne at Tangkhen Bay, Phuket Province, Thailand

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The genus *Halimeda*, a green alga (Chlorophyta), is widely distributed in tropical and sub-tropical marine environments. *Halimeda macroloba* Decaisne has several calcified segments, an erect and flat thallus and a massive bulbous holdfast for attachment to sandy bottoms. This bulbous holdfast may adhere to fine particles of loose substrate. The purpose of this project is to investigate the seasonal variation in distribution, density, and life stage of *Halimeda macroloba* Decaisne at Tangkhen Bay, Phuket Province, Thailand. To study distribution and population density, data has been collected every month for a year using sixty 0.25 m^2 quadrats placed along three transect lines. Twenty-one 0.25 m^2 permanent plots have been used to monitor life stage and life span of *H. macroloba*. The data set from this study will reveal the seasonal variation of *H. macroloba* population and what might cause such variation. The results so far of this study showed that the highest density was found in September 2006, at 38.13 thalli per m^2, while the lowest was found in October 2006, at 2.33 thalli per m^2. The seven-month dataset showed variation in density of *H. macroloba* in each substrate and month. The density of each life stage of *H. macroloba* varied with time of sampling ($P<0.05$). Newly recruited plants were found only in December 2006, at 0.14 thalli per m^2, while fertile plants were not found in this study. However, it does not show that there was no sexual reproduction in this population. Physical parameter analysis could explain the seasonal variation in the abundance of *H. macroloba.*

Biodiversity of freshwater bryozoans and biological monitoring trials of water quality in the Songkram River

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Since 2001 much progress has been made towards understanding freshwater bryozoans in Thailand. A team of scientists and students at Kasetsart University has now identified 20 species in Thai waters, including 6 described for the first time, bringing the total number of species worldwide to 86. The objective of this BRT project in Northeastern Thailand was to study bryozoans in the Songkhram River watershed, an area known for its high biological diversity. This included a series of trials to monitor water quality with local bryozoan species. We made trips to the area during June-July 2006 and January-February 2007. For the biological monitoring component, we grew colonies of *Hislopia malayensis* on plastic panels and deployed them at 10 established sites in the Songkhram River for at least one week. For the surveying component, we searched intensively for bryozoans in the river as well as in a number of ponds and lakes within the watershed. Results of this project included: (1) Verification of 11 bryozoan species occurring at 15 river and lake sites, including 3 species not reported elsewhere in Thailand, with much new information about the ecology of all species; (2) Results from biomonitoring trials were uneven. In general, growth and survival were much higher during the rainy season, suggesting that water quality during the dry season may not be as excellent as we had assumed.

Species diversity of calanoid copepods at the Surin Islands National Park, Phang-Nga Province

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The species diversity of calanoid copepods at the Surin Islands National Park, Phang-Nga Province, was investigated in January 2006. Zooplankton samples from 9 stations were collected by horizontally towed nets with 330 μm mesh size. A total of 27 species in 16 genera and 11 families were reported. Among them, 8 species in 6 genera were very common. Seven species in five genera in this study are first records for Thai waters of the Andaman sea: *Calanopia elliptica* Dana, *C. minor* A. Scott, *Candacia curta* (Dana), *C. pachydactyla* (Dana), *Eucalanus crassus* Giesbrecht, *Paracalanus aculeatus* Giesbrecht and *Undinula vulgaris* (Dana).

Communities of cyclopoid copepods in two wetlands: Bueng Boraphet, Nakhon Sawan Province and Bueng Khong Long, Nong Khai Province

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An investigation of cyclopoid copepods in two wetlands was carried out in 3 seasons, the rainy, cool and hot seasons, during August 2002 to April 2004. The cyclopoid copepod communities of Bueng Boraphet, Nakhon Sawan Province, comprised the following 6 species: *Eucyclops serrulatus* (Fischer), *Mesocyclops aspericornis* (Daday), *M. thermocyclopoides* Harada, *Microcyclops* sp., *Thermocyclops crassus* (Fischer) and *T. decipiens* (Kiefer). In the first year (August 2002-April 2003), average maximum and minimum abundances of 41±31 and 31±33 individuals/litre were recorded in the cool and rainy seasons, respectively. In the second year (August 2003-April 2004), average maximum and minimum abundances of 152±171 and 31±52 individuals/litre were recorded in the rainy and hot seasons, respectively. In Bueng Khong Long, 5 species were identified and two (*Ectocyclops polyspinosus* Harada and *Mesocyclops pehpeiensis* Hu) are new to Thailand. The others recorded from this wetland were *M. aspericornis, M. thermocyclopoides* and *Microcyclops* sp. In the first year, average maximum and minimum abundances of 57±66 and 39±40 individuals/litre were found in the hot and rainy seasons, respectively. In the second year, average maximum and minimum abundances of 160±126 and 111±77 individuals/litre were found in the rainy and cool seasons, respectively. However, the biodiversity and abundance in both wetlands during the first and second years and within the same season were not significantly different ($p>0.05$). Most of the taxa recorded are circumtropical species. In addition, the physico-chemical characteristics of water in these wetlands were suitable for natural living animals and fisheries.

Species diversity of ostracods in Srisaket Province

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A survey of species diversity of ostracods from Srisaket Province was conducted in winter (December 2006) and summer (April 2007). Samples were collected from temporary ponds, rice fields, reservoirs, canals, lakes and rivers using a 60 µm mesh plankton net. In each location, water quality parameters, including pH, water temperature, and conductivity, were measured. Nitrate and Phosphate concentrations were measured by a Hach model DR/2400 Portable Spectrophotometer. Geographic position (altitude) was measured by a Sportrak GPS Receiver. Specimens were preserved in 70% alcohol and identified under compound and stereo microscopes. Images of identified species were taken using a Leo 1450VP scanning electron microscope. 25 species of ostracod were identified: *Stenocypris* cf. *distincta*, *Stenocypris derupta*, *Dolerocypris* sp. *Chrissia* sp., *Strandesia kraepelini*, *Strandesia wierzejskii*, *Strandesia weberi*, *Strandesia lineata*, *Strandesia* cf. *wollterecki*, *Strandesia sexpunctata*, *Strandesia calapanensis*, *Strandesia richardi*, *Strandesia* sp. 1, *Strandesia* sp. 2, *Strandesia* sp. 3, *Cypridopsis aculeata*, *Cypridopsis* sp., *Pseudocypretta* sp. 1, *Pseudocypretta* sp. 2, *Pseudocypretta* sp. 3, *Physocypria* sp. 1, *Physocypria* sp. 2, *Physocypria* sp. 3, *Cypretta* sp. and *Hemicypris* sp.

Zooplankton dynamics in Kung Krabaen-Bay, Chanthaburi Province

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A study on zooplankton dynamics was conducted in Kung Krabaen Bay, Chanthaburi Province. Zooplankton comprised 15 phyla and 40 groups, which were divided into 22 groups of holoplankton and 18 groups of meroplankton. The average density ranged from 7.69×10^5 – 1.76×10^7 ind. 100 m^{-3}. Copepods dominated and contributed 49.92% of total zooplankton density. Crustacean nauplii, Gastropod larvae, Bivalvia larvae and Larvaceans were also found in abundance. Densities of Cladocera and Rotifera were related to seasonal variation. These groups were found in abundance during the southwest monsoon season or rainy season because they live mainly in fresh water and brackish water. The total density of zooplankton showed a higher density in the northeast monsoon season than in the southwest monsoon season. The zooplankton communities in the bay had greater similarity than those near the mouth of the bay as well as near the mangrove forest. However, the density of crustacean larvae varied significantly ($p=0.05$) in relation to the transparency of the water column. Biological factors such as chlorophyll_a positively influenced the population densities of Hydromedusae. Furthermore, the presence of predaceous zooplankton such as arrow worms, Hydromedusae and fish larvae would probably affect the density of Copepods and larvae of Mollusks, Polychaetes and Crustaceans. Brachyuran larval density was high near the mangrove forest in September and November 2004 because these were the breeding and egg laying seasons of mud crabs and blue swimming crabs. Therefore, it is necessary to reduce crab harvesting during this period to preserve and conserve natural crab stocks.

The zooplankton community in Pak Panang Mangrove Creeks, Nakhon Si Thammarat Province

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Zooplankton composition and abundance were studied in Pak Panang mangrove creeks, Nakhon si Thammarat province during 2006. Sample collections were conducted in 2 mangrove creeks in mangrove forest of 16 and 20 years of age. Total zooplankton density occurred in the ranges of 2.75×10^4 to 4.64×10^7 inds/100 m^3. Zooplankton communities were dominated by copepod nauplii, copepods, barnacle nauplii, gastropod larvae, bivalve larvae, mysid shrimps and lucifers. Mysid shrimps were the most frequent inhabitants throughout the study period. Peak densities of mysids were 3.92×10^5 inds/100m^3 in July and 1.10×10^5 inds/100m^3 in September in the 16-year-old and 20-year-old forests, respectively. The economically important Grapsid crab showed a maximum zoea density of 7.20×10^4 inds/100m^3 in November. Pearson correlation coefficients indicated a negative relationship between the abundance of copepod nauplii and the amount of dissolved oxygen but a positive one between the abundance of mysids and transparency depth.

พืช

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.

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 (*Fissdens 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.

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

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Microsorum 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.

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 circumsriptions, 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*.

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 palustriff*, *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.

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 µm) to large (0.81 µm). 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 µm) to large (50-100 µm) 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..

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.

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 *Salomonia*, 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 *Salomonia* 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 *Salomonia*, 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 *Salomonia*, the presence of papillae and cuticular ornamentation on the outer surfaces of capsules are supposed to be helpful features in species identification.

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 electon 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.

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.

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 *trn*L intron and *trn*L-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.

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 Eragostideae (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 Eragostideae, 18 species in *Indigofera* and five genera and 28 species in Myrtaceae are enumerated. Descriptions, photographs, vernacular names, distributions and ecological information are provided.

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.

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.

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 knowledg-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>.

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 arvorum* 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.

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

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A. sericea Craib, *A. mahidolae* Burtt et Chermsirivathana 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 tax a 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.

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 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.

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 *ndh*F, *trn*L- F, *psb*A-*trn*H 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.

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.

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.

Diversity of vascular plants along Bangwan and Tamnang 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.

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

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A study, in its 2nd 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.

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.

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*).

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^2) 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.

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.

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.

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.

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.

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

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The viability of *Cymbidium finlaysoniaum* 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.

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.

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.

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.

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.

สัตว์ไม่มีกระดูกสันหลัง

Introduction of aquatic organisms to Thailand via the aquarium trade

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The spread of introduced species causes problems both nationally and internationally. The introduction of invasive species not only has an impact on biodiversity but also has an impact on the health of humans and animals. Pathways of introduction include intentional release, illegal import, and ships. At present, in Thailand, only a few studies have investigated the effects of invasive species on natural habitats and compiled lists of introduced species via the aquarium trade. To manage or predict the impact of introduced species, which have been released accidentally, information on species and quantities of imported organisms are needed. Such information will also help in establishing plans to prevent the spread of introduced species in the future. In this study, aquatic species (freshwater and marine species) introduced via the aquarium trade were surveyed at Chatujak Market. We assessed the potential risks of introducing aquatic species associated with stores that sell aquatic ornamental species by designing a survey that inquired about: 1) types and quantities of aquatic species being imported; and 2) store managers' familiarity with aquatic invasions. The results showed that freshwater species had a higher risk of becoming invasive species in Thailand than do marine species. To prevent future aquatic and marine invasions, better reporting requirements for live species imports are needed.

Antitubercular marine-derived sesterterpenoid derivatives

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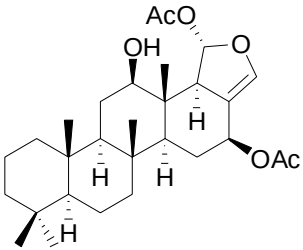
Heteronemin (**1**) is a marine natural product isolated as a major component from the sponge *Hyrtios* sp. The compound was previously reported to be strongly active against *M. tubercolosis* (MIC 6.25 μg/mL), however with a strong cytotoxicity. In order to determine the structural moieties that could be responsible for either activity, a scaffolding structural development was established, and a series of chemical derivitizations were carried out. This included hydrolytic cleavage with $BF_3.OEt_2$, and chlorochromate oxidation on the available hydroxyl group. The detailed chemical derivatizations and activities will be presented.



heteronemin (**1**)

An acetylcholinesterase-inhibiting steroidal alkaloid from the sponge, *Corticium* sp.

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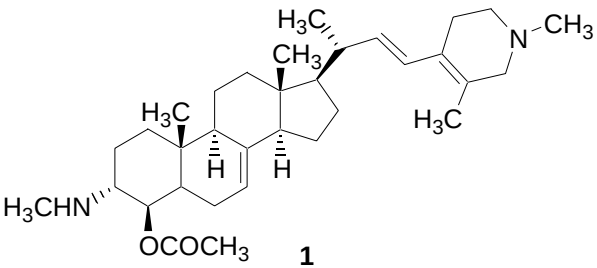
A methanolic extract of the Thai marine sponge *Corticium* sp. collected from the Gulf of Thailand showed 95.19±2.6% inhibition of acetylcholinesterase (AChE) when tested at 0.1 mg/mL using a microplate reader assay. Enzyme inhibition assay-guided purification led to the isolation of a new steroidal alkaloid. The structural determination of the alkaloid, 4-acetoxy-plakinamine B **(1)**, was achieved by means of spectroscopic analysis including 1D and 2D NMR, MS, IR and UV spectroscopy. The alkaloid exhibited good inhibition activity against AChE with an IC_{50} of 3.75±1.69 μM. The kinetics of enzyme inhibition was determined to reveal a reversible type of inhibition with an increased K_m and decreased V_{max} upon addition of compound **1**, thus suggesting a mixed-competitive inhibition.



1

Effect of wounding on renieramycin M concentration in *Xestospongia* sponges

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Every wounded sponge showed a significant increase of renieramycin M content from an initial level ($p < 0.001$). However, one month after cutting, renieramycin M concentrations were not significantly different. The greatest increase in renieramycin M was 3 hours after the initial cut. The content of renieramycin M was 218.8 µg/g dry weight of sponge. Renieramycin M was not detectable after an initial cut of these sponges. Then, the content of renieramycin M rapidly decreased at an estimated 22.162 times above the initial concentrations within the first 24 hours. Renieramycin M content declined to 0.39 times above the initial concentrations per day from the 4th day until the 90th day. By day 90 after the initial cut, the content of renieramycin M in every sponge was nondetectable.

New ergosterol peroxide and isonitrile diterpene compounds from the sponge *Ciocalapata* sp.

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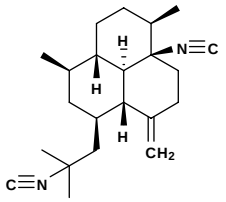
Screening for antimalarial activity of hexane-, CH_2Cl_2-, and MeOH-extracts of the Thai sponge *Ciocalapata* sp. showed that the highest activity occurred for the hexane-extract (IC_{50} 0.05 µg/mL). The hexane-extract was further investigated for active compounds using chromatographic techniques leading to the isolation of an isonitrile diterpene and a sterol peroxide. The diterpene was identified to be 8,15-diisocyano-11(20)-amphilectene (**1**) by means of spectroscopic analyses and X-ray crystallography. An ergosterol was obtained from reverse phase HPLC and it was identified as ergosterol peroxide (**2**). The biological activity of all isolated compounds will be presented.



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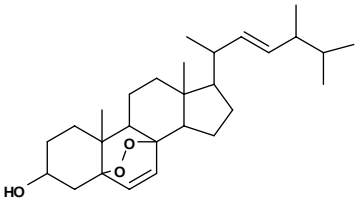

2

Impacts of the Tsunami on coral recruitment at Mu Koh Surin National Park, Phang Nga Province

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Mu Koh Surin is a group of offshore islands in the Andaman Sea, located about 60 km from the mainland of Phang Nga Province, southern Thailand. It is recognized as one of the best diving spots. The 2004 tsunami caused severe damage to certain reef sites, especially those located in channels between islands which lie in an east-west direction, such as the channel between South Surin Island and Torinla Island. The present study concentrates on impacts of the tsunami on coral recruitment at Mu Koh Surin by using settlement plate experiments and field observations of juvenile coral colonies. Densities of juvenile corals at Ao Mai Ngam, Ao Pagkard, Ao Tao, Ao Maeyai and Ao Jak of Mu Koh Surin had decreased by 68.40%, 65.10%, 38.60%, 44.10% and 30.70 %, respectively. The main groups of juvenile corals that had decreased were *Galaxea*, *Fungia*, *Pocillopora*, *Acropora* and *Porites*. The settlement plate experiments showed that there was much variation in coral recruitment rates. The highest density of coral recruits on settlement plates was at Ao Pagkard while the lowest was at Ao Suthep. Certain high tsunami impacted reefs, such as Ao Pagkard, showed clear natural recovery trends. There should be preventive measures taken to limit anthropogenic impacts on coral reefs at Mu Koh Surin to accelerate natural coral recruitment rates.

The developmental stages of the staghorn coral *Acropora humilis*

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The sexual reproduction of the scleractinian staghorn coral, *Acropora humilis*, at the Naval Military Base, Sattahip, Chonburi Province, Thailand was investigated. This coral is a hermaphroditic broadcasting species that is commonly found in the Gulf of Thailand. In this study, gametes in bundles were collected directly underwater using a gamete collector during their spawning season in February 2006 and 2007. The collected bundles were carefully transferred to a fertilization tank in a land-based hatchery. The bundles from different colonies were mixed together for fertilization. Then, the morphological development stages of *Acropora humilis* larvae were observed every hour. The first equal cleavage division was observed one hour after the eggs were fertilized. The cell then started dividing quickly, and changed to the prawn-chip stage after 8 hours. After 18 hours, the shape of fertilized eggs became round again with folded edges. Cilia developed after 36 hours and the larvae started swimming slowly; this stage was called the planula larva. After 3-days old, the planulae started searching appropriate areas for settlement by swimming near the bottom of the rearing tank due to their negative phototaxic behavior. From this study, the time period of each developmental stage may be different in different areas depending on physical factors, such as sea water temperature and light.

Macrobenthic fauna communities in human activity areas in the Lower Songkhla Lake

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This research investigated and compared the distribution of macrobenthic fauna in areas in the Lower Songkhla Lake where there are, and are not, significant human activities. Study stations were set on transect lines, with each line divided into 5 substations beginning at the shore and extending into the lake at distances of 2, 50, 100, 200 and 300 m. Macrobenthic fauna were collected every 3 months from March to December 2006. BOD values for the area with low human activity (1.6 - 2.0 mg l^{-1}) were markedly lower than at the area with high human activity (4.4 - 15.9 mg l^{-1}), with the highest reading at a distance of 2 m from the shore. DO values at distances 2 - 100 m from the shore of the latter area were close to the critical point. Organic matter sediment was also higher at the high human activity area (3.9 - 5.9%) than at the low human activity area (3.1 - 5.3%) with a gradual reduction in values as distance from the shore increased for both areas. These were related to the species diversity of macrobenthic fauna which was very low for the human activity area; in particular at the distances of 2 and 50 m there was almost nothing. At 100 m, a high density of fauna was found but only for the oligochaetes (80,000 ind/m^2). The low human activity area had amphipods, tanaidaceans, polychaetes and molluscs along the transect line.

Comparison of interstitial faunal communities between Phromsong and Phromlaeng streams, Nam Nao National Park, Petchabun Province

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Many freshwater invertebrate metazoans inhabit the subsurface sediment of streams and rivers. This investigation of the interstitial fauna community was conducted in Phromsong and Phromlaeng streams, Nam Nao National Park, Petchabun province, during October 2004 to June 2005. Interstitial fauna and sediment were collected from 0-5 and 5-10 cm with a 4 cm diameter PVC standing-pipe. The samples were taken at two month intervals. The results showed that natural seasonal droughts and spates of high water occurred only in Phromsong stream. Grain size of sediment in this stream is more diverse and coarser than that of Phromlaeng stream. In Phromlaeng stream, the water flow regime is more constant, and sand and organic matter are predominant. Sand and organic matter may be trapped by log dams formed during times of high water. Total dissolved solids of surface and subsurface water in Phromsong stream were lower than those of Phromlaeng stream, while dissolved oxygen of this site and in surface water were higher. Results of analysis of physico-chemical parameters of surface water revealed the seasonal variation of these streams. Temporary meiofauna groups were significantly more abundant in Phromsong stream ($p \leq 0.05$). Gastrotrich and monogonont rotifers were more abundant in Phromlaeng stream but tardigrades and Acarina were more abundant in Phromsong stream. In both streams, bdelloid rotifers were the most abundant group. Among temporary meiofauna, chironomid larvae were more abundant than other groups. The results of cluster analysis show that the interstitial faunal communities of both streams were different which correspond with the physical characteristics of the streams.

Cercarial infections of freshwater snails (Family Thiaridae) in the northern part of Thailand

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Cercarial infections of freshwater snails (Family Thiaridae) in the northern part of Thailand, were studied at twenty-six different water sources. The snails were collected every two months for one year for each location; collection started and ended at varying times between December 2004 and July 2006. Eighteen species of freshwater snails were found: *Tarebia granifera*, *Melanoides tuberculata*, *Melanoides jugicostis*, *Thiara scabra*, *Paracrostoma pseudosulcospira pseudosulcospira*, *Paracrostoma paludiformis paludiformis*, *Paracrostoma paludiformis dubiosa*, *Paracrostoma morrisoni*, *Brotia (Brotia) binodosa binodosa*, *Brotia (Brotia) microsculpta*, *Brotia (Senckenbergia) wykoffi*, *Brotia (Brotia) pagodula*, *Brotia (Brotia) binodosa spiralis*, *Brotia (Brotia) insolita*, *Brotia (Brotia) manningi*, *Brotia (Brotia) costula costula*, *Brotia (Brotia) baccata* and *Brotia (Brotia) citrina*. The cercarial infections were investigated using shedding and crushing methods. Ten species of cercariae were found from 18 locations. They were *Haplorchis pumilio* (CtN_1), *Haplorchis taichui* (CtN_2), *Centrocestus formosanus* (CtN_3), *Acanthatrium hitaense* (CtN_4), *Loxogenoides bicolor* (CtN_5), *Haematoloechus similis* (CtN_6), *Cloacitrema philippinum* (CtN_7), *Cardicola alseae* (CtN_8), *Alaria mustelae* (CtN_9), and *Transversotrema laruei* (CtN_{10}). Seven species of snails were trematode hosts (1st intermediate hosts). They were *T. granifera* [(CtN_1), (CtN_3), (CtN_4), (CtN_5), (CtN_6), (CtN_8),(CtN_9), (CtN_{10})], *M. tuberculata* [(CtN_1), (CtN_2), (CtN_3), (CtN_4), (CtN_5), (CtN_6), (CtN_7), (CtN_{10})], *T. scabra* [(CtN_1), (CtN_2), (CtN_4), (CtN_5), (CtN_6), (CtN_{10})], *P. p. paludiformis* [(CtN_6)]; *B. wykoffi* [(CtN_5), (CtN_6)]; *B. c. costula* [(CtN_1), (CtN_5), (CtN_6)] and *B. citrina* [(CtN_1), (CtN_5), (CtN_6)]. *T. granifera* was infected by several kinds of cercariae. The infection rate of *T. granifera* was 5% (1,241/24,862).

Cercarial infections of freshwater snails (Family Thiaridae) in the Northeast of Thailand

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Cercariae, the larval stages of trematodes, were investigated in the freshwater snail family, Thiaridae, in the Northeast of Thailand. Thiarid snails are classified in the Phylum Mollusca, Class Gastropoda, Subclass Prosobranchia, Order Mesogastropoda. In Thailand, Brandt (1974) classified thiarids into 2 subfamilies: Thiarinae and Melanatriinae. There are 8 genera and 27 species of thiarid snails in Thailand. In this study, species diversity was recorded and habitats were examined for physical and chemical properties such as temperature, rate of water flow, conductivity, turbidity, dissolved oxygen and pH of water. The snails were collected by handpicking and scoop methods using counts per unit of time and the collected snails were identified. Thiarid snails were found in twenty-eight locations in the Northeast of Thailand. The snails were collected every other month for one year. Nine species of freshwater snails were found. The cercarial infections were investigated using shedding and crushing methods. Ten species of cercariae were found from 20 locations. This study can be used as a source of information on the biological diversity of parasitic infections in snail intermediate hosts of animal and human parasitic trematodes.

Population dynamics of the blue swimming crab *Portunus pelagicus* (Linnaeus, 1758) at Khung Krabaen Bay, Chanthaburi Province

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This study aimed to analyze the population dynamics of the blue swimming crab in Khung Krabaen Bay, Chanthaburi Province, from January to December 2005. The results of this study indicated a decline in crab production from 80 tonnes/year in 2004 to 62 tonnes/year in 2005. The sex ratio of males to females was 1:1.19. Statistical analysis showed significant differences in the seasonal distribution of crabs, with high numbers in the winter season, followed by the rainy season and dry season. The relationships between carapace width and weight were $W = 0.0002CW^{2.7692}$ and $W = 0.0004CW^{2.6067}$ in male and female crabs, respectively. Growth parameters for male crabs were $L_{\infty} = 13.23$ cm and $K = 0.87$ per year while growth parameters for female crabs were $L_{\infty} = 12.95$ cm $K = 1.05$ per year. Total mortalities of male and female crabs were 3.17 and 3.55 per year, respectively. Recruitment occurred all year but it showed two peaks. The first peak was during February to March and the second peak was during July to October. The size at sexual maturity of female crabs was 8.1 cm. Spawning of berried females occurred all year round with two peaks in September and January. The main foods of the crabs were fish, crustaceans and mollusks. For appropriate management of the blue swimming crab fishery, there should be: 1) a 6 month closed spawning season from July to December to allow recruitment recovery while providing compensation to fisherman; 2) an increase in mesh size to not less than 2.5 inches; 3) a ban on berried female crabbing; 4) protection of seagrass habitats as crab nursing grounds; 5) promotion of restocking and crab culture; and 6) education and publicity concerning sustainable fishing.

Diversity of Protura in Doi Inthanon National Park

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Proturans (Insecta, Protura) will be collected along an altitudinal gradient in Doi Inthanon National Park, Chiang Mai Province. Five different forest types will be chosen at 500 m intervals including dry deciduous dipterocarp forest, mixed deciduous forest, lower evergreen forest, upper evergreen forest, and summit cloud forest. At each site, a plot of one hectare will be established and further divided into 12 sub-plots. Ten soil samples will be collected monthly using 15 × 15 cm quadrats at a depth of 5 cm along a 100 m line transect at 10 m intervals located in each subplot. The soil samples will then be transferred to Berlese funnels with a light heating system for 72 hr. The proturan specimens will be separated and permanent slides will be made for each individual. Taxonomic information will be given. Species richness and species abundance values will be calculated. Biological data and environmental variables will be analysed using various statistical techniques (e.g. multivariate and univariate analyses). Multivariate analyses will be applied for explaining the ecological data by computer software, such as the PATN package which includes ordination and clustering by Semi-strong Hybrid Multidimensional Scaling (HMDS) and Two-way Indicator Species Analysis (TWINSPAN). Univariate analyses will be used for comparing abundances of species or environmental variables by Analysis of Variance (ANOVA) in the statistical SPSS package. The actual number of species present in each forest will be calculated and compared with the observed number using EstimateS 7.5 software.

Cytogenetic and molecular evidence for two species in the *Anopheles barbirostris* complex (Diptera: Culicidae) in Thailand

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Seventeen isolines of *A. barbirostris* derived from animal-biting females showed 3 karyotypic forms: Form A (X_2, Y_1), 5 isolines (Phetchaburi); Form B (X_1, X_3, Y_2), 3 (Chiang Mai) and 8 (Ubon Ratchathani) isolines; Form C (X_2, Y_3), 1 isoline (Phetchaburi). All 17 isolines exhibited an average branch summation of seta 2-VI pupal skins ranging from 12.1-13.0 branches, which was in the limit of *A. barbirostris* (6-18 branches). Of the 12 human-biting isolines from Chiang Mai province, 5 isolines showed Form B (X_2, Y_2) and 7 isolines exhibited a new karyotypic form designated as Form E (X_2, Y_5). All 12 isolines had an average branch summation of seta 2-VI pupal skins ranging from 22.4-24.5 branches, which was in the limit of *A. campestris* (17-58 branches). Thus, they were tentatively designated as *A. campestris*-like Forms B and E. Crossing between *A. campestris*-like Forms B and E yielded viable progenies, suggesting conspecific relationships. Reproductive isolation among crosses between *A. campestris*-like Form B and *A. barbirostris* Forms A, B and C strongly suggested the existence of these 2 species. The very low intraspecific variation (genetic distance < 0.005) of ITS2, COI and COII of *A. campestris*-like Forms B and E supported their conspecific relationship. The large sequence divergence of ITS2 (0.203-0.268), COI (0.026-0.032) and COII (0.030-0.038) of *A. campestris*-like Forms B and E and the *A. barbirostris* Forms A, B and C clearly supported cytogenetic and morphological evidence.

Distributions of black flies in Thailand

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A faunistic survey of Simuliidae at 40 sites in northern, southern and central Thailand was made during July 2006-January 2007. A total of 34 *Simulium* species were collected, of which one new southern species, *S. adleri*, collected from Bang Thao Mae waterfall, Krabi province, was assigned to the *batoense* species-group of the subgenus *Gomphostilbia* on the basis of the slender, parallel-sided hind basitarsus of the male. The larva of the new species is distinguished from those of other species in the same species-group by a postgenal cleft that extended less than half the distance to the hypostomal groove and by a dark grey-banded abdomen interrupted on abdominal segment VI by a lack of pigment. Ten species (*S. asakoae*, *S. siamense*, *S. caudisclerum*, *S. fructicosum*, *S. merga*, *S. mediocoloratum*, *S. chamlongi*, *S. nigrogilvum*, *S. doipuiense* and *S. weji)* were restricted to some northern sites whereas three species *(S. adleri*, *S. grossifilum* and *S. nobile*) were found only in southern sites. Differences in distribution and species composition of black flies seem to correlate with altitude as well as micro-habitat factors such as stream sizes, water temperature and water velocity.

Development of a biotic index for rapid bioassessment in the Mekong II Basin, Thailand

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Biological monitoring of freshwater is a use made of ambient biological communities, assemblages, and populations to protect, manage, and even exploit water resources. In addition to protecting the health and lives of humans, plants and aquatic animals, and environmental quality, biological monitoring can also be used to manage wider areas, i.e., all catchments, or evaluate stream ecology for protection. The aim of this project is to develop a standard rapid bioassessment procedure for streams in Thailand by following the Rapid Bioassessment Protocol of the USEPA (Barbour et al., 1999). The study was conducted in 20 streams of the Mekong II Basin (in the Thailand part). Spatial and temporal structure and composition of macroinvertebrate communities were considered. Environmental and physicochemical parameters were measured. During the last 5 seasons, 84 sampling stations were sampled. Fifty-one reference and 33 test sites were classified based on location and surrounding environments. Total habitat scores were significantly higher ($p<0.05$) in reference sites than those of test sites for all seasons. Some physicochemical parameters of water quality at reference and test sites were different between seasons. Most water quality parameters were significantly different ($p<0.05$) between seasons at both reference and test sites. In this study, four phyla, 20 orders, 101 families, 194 taxa, and 24,763 individuals of macroinvertebrates have been found so far. The study is ongoing. The total no. of taxa, intolerant taxa, % intolerant organisms, Beck's biotic index, no. of clinger taxa, % dominant taxon, % chironomidae, and no. of trichoptera taxa are potential candidate metrics for developing a bioassessment index in the basin.

Ecological genetics and reproductive isolation of fruit fly parasitoids in the *Diachasmimorpha longicaudata* complex in Thailand

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Parasitoids are beneficial wasps that are useful in biological control. The parasitoid *Diachasmimorpha longicaudata* parasitizes fruit fly larvae which infest many commercially grown fruits. Several researchers have suggested that the taxon *D. longicaudata* is probably a species complex. Can these species complexes be used together for biological control? Answers to this question require a thorough understanding of host and parasitoid species. Thus, it is necessary to undertake genetic investigations of *D. longicaudata* populations in the field to understand their genetic structure and to elucidate their taxonomic status. Although genetic differences can ensure species isolation among species in a complex, it is still important to verify reproductive isolation. Cross breeding experiments can investigate reproductive isolation among such populations. If the populations of different species interbreed, the resulting offspring are either abnormal in number, unviable or infertile. The need to optimize the use of each parasitoid species in terms of their effectiveness is also necessary for a biological control program. Hence, the objectives of this project are: 1) to evaluate levels of genetic variation in natural populations of the *D. longicaudata* complex by using the SSCP technique; 2) to compare DNA sequences and to construct phylogenetic trees; 3) to determine the mode of reproductive isolation within the *D. longicaudata* complex; 4) to determine host choice by comparison of foraging and oviposition behavior among members of the *D. longicaudata* complex; 5) to study the co-evolution of hosts and parasitoids in this interesting group.

Genetic diversity of the *Diachasmimorpha longicaudata* complex in Thailand based on PCR-SSCP of 28S, 16S and ITS regions

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Species of the *Diachasmimorpha longicaudata* complex are parasitoids considered useful for classical biological control. The morphological similarity among species in the complex is a crucial classification problem. If genetic polymorphisms are present, then this problem may be solved. One efficient molecular technique that has been used for scanning genetic diversity is SSCP (single strand conformation polymorphism) analysis. The 28S, 16S and ITS genes are commonly selected for this technique because of their great significance for discrimination among closely related species. The polymorphisms of these genes can be detected by SSCP. Then different haplotypes of PCR products are sequenced. These sequenced genes are used to construct phylogenetic trees to analyze relationships and genetic structure within populations of this species complex in Thailand. This useful technique can be applied for further classification within other parasitoid species complexes.

Species diversity of stingless bees (Apidae, Meliponinae) in the north of Thailand

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A study of the species diversity of stingless bees (Apidae, Meliponinae) was conducted in northern Thailand during June 2005 to December 2006. A total of 500 nests of stingless bees was found at different nesting sites, i.e., underground, termite mounds, buildings or constructions, and tree trunks. All specimens were identified into 15 species in 2 genera: *Hypotrigona scintillans*, *Trigona apicalis*, *T. collina*, *T. fimbriata*, *T. itama*, *T. laeviceps*, *T. latigenalis*, *T. fuscobalteata*, *T. geissleri*, *T. melanoleuca*, *T. nitidiventris*, *T. peninsularis*, *T. terminata*, *T. thoracica*, and *T. ventralis*. They are distributed in areas in which altitude ranges from 45 – 1,700 meters above sea level.

Relationships of brittle stars with sponges at the Lan Islands, Chonburi Province

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The relationship between sponges and brittle stars on the coral reef of the Lan Islands, Chonburi Province, the Gulf of Thailand, was studied during April 2005 to March 2006. Sponges in the Class Demospongiae that were associated with brittle stars were classified into 5 Orders, 2 Suborders, 19 Families, 21 Genera, and 25 species. The dominant species was *Iotrochota baculifera* (38%), followed by *Xestospongia testudinaria* (19%), *Hyrtios erecta* (8%), *Neopetrosia* sp. (6%), *Haliclona amboinensis* (5%), *Phobas arborescens* (4 %) and *Clathria (Thalysias) reinwardti* (4%). Associated brittle stars in Class Ophiuroidea were classified into 1 Order, 3 Families, 5 Genera, and 14 species. Among these, 11 species had disk diameters less than 10 mm and 3 species had disk diameters more than 10 mm (*Macrophiothrix aspidota*, *M. variabilis* and *Ophiothrix (Placophiothrix) fumaria*). The dominant species was *Ophiactis savignyi* (73%) which was associated with 24 sponges, while *O. exigua* (6%) was associated with 14 sponges. Volumes of sponges had no significant relationships with species, numbers and sizes of brittle stars. The sponge associated with the most numbers of brittle star species was *Iotrochota baculifera* (9 species) followed by *Hyrtios erecta* (8 species), *Clathria reinwardti* (7 species), *Pseudoceratina* sp. (6 species) and *Neopetrosia* sp. (6 species). This study indicated that *O. savignyi* had specific relationships with *Mycale grandis*, *Callyspongia (Euplacella) joubini* and *Gelliodes petrosiodes*, *O. exigua* had a specific relationship with *C. subarmigera*, and *O. maculosa* had a specific relationship with *Biemna fortis*. In conclusion, the factors affecting associations of brittle stars with sponges are the morphology and distribution of sponges.

สัตว์มีกระดูกสันหลัง

Effects of different food on growth and ecteinascidins production of the tunicate *Ecteinascidia thurstoni* Herdman, 1891

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The Thai tunicate, *Eceinascidia thurstoni* Herdman, 1891, found around Phuket Island, is the first Asian tunicate determined to contain ecteinascidins. This compound exhibits potent cytotoxic activity against cancer cells. Culturing of *E. thurstoni* is one of the methods to increase ecteinascidin production. However, appropriate diets that can maximize both growth and ecteinascidin productions are unknown. In this study, *E. thurstoni* were fed either a single diet or a combination of two diets of the following: *Chaetoceros gracilis*, *Isochrysis galbana*, *Nannochloropsis* sp., or formulated shrimp feed. The experiments were conducted for two life cycles of *E. thurstoni*, and then zooids from each treatment were collected for ecteinascidins analysis. The results showed that *E. thurstoni* fed only *C. gracilis* had the best growth in zooid number, probably due to the high nutritional value of *C. gracilis*, while the lengths of zooids were not different compared to tunicates fed on other diets. The highest percent coverage of zooids per colony was also found for the tunicates fed on *C. gracilis*. Ecteinascidins production of the tunicates fed on only *C. gracilis* also showed the highest ecteinascidins production. Thus, the results showed that *in vitro* culture is a possible method to increase the production of this anti-tumor compound.

A new Thai Mesozoic lungfish (Sarcopterygii, Dipnoi) with an insight into post-Palaeozoic dipnoan evolution

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We describe a new species of lungfish, *Ferganoceratodus martini* sp. nov., based on a single specimen discovered in the Late Jurassic – Early Cretaceous of the Phu Nam Jun locality, north-eastern Thailand. The material comprises an almost complete skull roof with associated upper and lower jaws, as well as some postcranial remains. *F. martini* shows characters unexpected and/or unknown in other Mesozoic lungfishes, such as pieces of a 'hard snout'. The microstructure of the 'hard snout' provides support to the Bemis and Northcutt interpretation of the cosmine tissue of Palaeozoic lungfishes as homologous to the complex cutaneous vasculature of the living *Neoceratodus*. Because the homologies of the ossifications of the skull roof among lungfishes and among piscian sarcopterygians are unsatisfactorily understood, we use a topological nomenclature in the description of the specimen and in the discussion of post-Devonian dipnoan skull roof characters. We define a few characters for cladistic analysis only, but these are regarded as less theory-laden. We propose a hypothesis of phylogenetic relationships for most of the post-Devonian forms known by skull remains. The main feature is the ancient dichotomy between the *Neoceratodus* lineage and most of the other Mesozoic forms, including the Lepidosirenids. The palaeobiogeographical pattern shows a series of vicariant events between Laurasia and Gondwana in the Late Triassic – Early Jurassic, followed by a vicariant event between Africa and South America

A new semionotiform (Actinopterygii, Neopterygii) from Upper Jurassic – Lower Cretaceous deposits of north-east Thailand, with comments on the relationships of semionotiforms

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A new semionotiform fish, *Isanichthys palustris* gen. et sp. nov., is described from the Late Jurassic – Early Cretaceous Phu Kradung Formation of north-east Thailand. *I. palustris* is known from a single, nearly complete specimen found alongside abundant *Lepidotes* specimens at the Phu Nam Jun locality. *I. palustris* shows a mixture of semionotidlike characters, such as the pattern of cheek ossifications, and lepisosteid-like characters, such as the body shape and a dorsal fin opposed by an anal fin. *I. palustris* possesses only some of the characters currently used to define the Semionotidae. Cladistic analyses including various semionotid and gar taxa, together with *Amia calva* and *Leptolepis coryphaenoides*, suggest that the Semionotiformes (Lepisosteidae and 'Semionotidae') form a monophyletic clade, but the 'Semionotidae' taxa form an unresolved polytomy. The relationships between Semionotiformes, Halecomorphi and Teleostei are unresolved. When restricted to the best-known taxa, however, the analysis shows the monophyly of the Semionotidae *sensu stricto (Semionotus + Lepidotes)* and a sister-group relationship between halecomorphs and teleosts. These last two results are regarded as the preferred hypothesis for further studies. *I. palustris* is the only known example of a predaceous, probably piscivorous, 'semionotid'. It illustrates the great diversity and ecological adaptation of the semionotiforms during the Late Jurassic – Early Cretaceous. We question the phylogenetic relationships of 'ancient fishes' founded on molecular-based trees because we suspect that the use of very few Recent taxa as representatives of previously diverse lineages is an inevitable, but important, bias in the construction of such trees.

Histological studies of the alimentary system in the adult spotted scat, *Scatophagus argus* Linnaeus, in mangrove forests of the Pak Phanang Estuary, Nakhon Si Thammarat Province

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Histological studies of the alimentary system, beginning with the mouth parts, confirmed that adult *Scatophagus argus* are mainly benthic omnivores. The dominant prey items were microplankton, protozoans, zooplankton, benthos and detritus. These fish have subterminal mouth and short gill rakers as good indicators. Villiform teeth appear on the maxilla and mandible in an inner band of 6-7 rows. Average teeth sizes were 131.67 μm on the maxilla and 42.25 μm on the mandible. Ciliiform teeth also appeared on the tongue. Enlarged esophagus mucosa and muscularis layers were 224.22±28.24 μm and 379.90±198.88 μm, respectively. The stomach was U-shaped with numerous pyloric caecae (10-20) allowing optimal absorption of diverse prey items. A mucus-secreting gland and gastric glands in the stomach helped facilitate digestion. The cardiac organ had mucosa and muscularis layers of average 239.01±21.17 μm and 205.32±72.63 μm, respectively. The fundus had a mucosa layer of 322.05±20.70 μm and a muscularis layer of 237.31±70.31 μm. The thicknesses of the mucosa and muscularis layers in the pyloric portion were 605.15±142.45 μm and 600.24±155.44 μm, respectively. The intestine length/body length ratio varied from 1.8-3.3. Mucus-secreting goblet cells, which aid in the absorption of nutrients, were found in the highest number. The bile duct from the liver and gall bladder together with enzymes from the pancreas all enter into the duodenum portion. In the duodenum, the average thickness of the mucosa layer was observed to be the greatest. The liver had the highest number of fat-storing cells. These histological studies of the alimentary system in adult scats correlates with the relative importance of components in their diet.

Taxonomy of spiny eels (Synbranchiformes: Mastacembelidae) in the Chao Phraya River Basin

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The main purpose of this study was to review and investigate the taxonomy of spiny eels. The study was based on the examination of mastacembelid specimens deposited in museums and, in addition, collected throughout the Chao Phraya River Basin, Thailand, during the period June 2006 to June 2007. For each specimen, 40 morphometric measurements and 13 meristic characters were taken. Numerical data were explored and analysed by principal component analysis (PCA) and Mann-Whitney U tests. PCA performed on the correlation matrix of log-transformed measurements and raw meristics were used for exploring multivariate data sets while Mann-Whitney U tests were used for univariate comparisons. Both the morphometrics and meristics could be used to alleviate difficulties with the identification of individual specimens. A total of six species in two genera, *Macrognathus siamensis*, *M. semiocellatus*, *M. circumcinctus*, *Mastacembelus armatus*, *M. favus*, and *M. erythrotaenia*, were recorded in the river basin. Most *Macrognathus* were found at the bottom of slow-flowing or standing waters and floodplain areas except for *M. circumcinctus*, whereas *Mastacembelus* spp. were found along the bottoms of flowing rivers including streams. *M. siamensis* is perhaps the commonest species of spiny eel in Central Thailand.

Species composition and distribution of fish larvae at Maeklong Estuary, Samut Songkram Province

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Species composition and distribution of fish larvae in Maeklong Estuary, Samut Songkram Province, were studied from June 2004 to June 2005. Nine sample stations were operated every month. A total of 37,523 fish larvae were found. The results showed that the fish larvae comprised 19 families in the study area of which 10 were economic families. The most widely distributed fish larvae were Gobiidae. The next highest were Clupeidae, Ambassidae, Blenniidae and Engraulidae. The highest density of fish larvae was found in January 2005 with a density of 108,582 larvae / 1,000 m of seawater, while the lowest abundance of fish larvae was recorded in June 2004 with a density of 2,161 larvae / 1,000 m of seawater.

Relationships between fish assemblages and complexity of coral habitat at Chao Lao beach, Chantaburi Province

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Relationships between fish assemblages and complexity of coral habitats was studied by using a fish visual census method and line intercept method. Forty-one species in 24 genera and 14 families were found. The results showed that the diversity of fish in the area was low when compared with other areas on the east coast of the Gulf of Thailand. Dominant groups were damselfish, snapper, and wrasse. There was a positive correlation between the complexity of coral habitats and the diversity and density of fish species and this was similar for each coral life form. However, there was a negative correlation between the density of fish and dead coral and sand composition. The results also showed that small-sized fish used coral cavities as shelter. Relationships between fishes and physical factors (depth, salinity, visibility) were different for each species. No effect from tourism on the reef fish assemblage was found because the main tourism activity was glass-bottomed boat tours. But tourism affected the damselfish. High tourism activity caused low densities of damselfish because tourism activity disturbed damselfish. For future tourism management, it is necessary to control the behavior of tourists and waste deposal from the numerous resorts along the beach.

Variation and distribution of mercury in the tissues of aquatic organisms caught from Songkla Lake

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Accumulation of mercury (Hg) in fishery resources in Songkla Lake (SKL) may lead to a high risk to consumers via the food chain. This study assessed mercury contamination in economic aquatic species in the SKL which were collected from local piers, markets and directly from fishermen in 6 surveys around the SKL during August 2004 to July 2005. Identification of 218 samples determined 3 herbivorous fish species, 10 omnivorous fish species, 34 carnivorous fish species and 8 shrimp species. Mercury (Hg) content in edible tissues was measured using Hydride Generation Atomic Absorption Spectrometry after digestion with nitric acid (HNO_3) and sulfuric acid (H_2SO_4). The results reveal that the concentration of Hg in carnivorous fishes > omnivorous fishes > herbivorous fishes ~ shrimps. Average (minimum – maximum) and median Hg concentrations in carnivorous fishes were 95 ± 108 (11–625) and 68 ng/g wet weight, in omnivorous fishes were 36 ± 22 (12 – 66) and 33 ng/g wet weight, in herbivorous fishes were 33±32 (12 – 70) and 17 ng/g wet weight, and in shrimps were 15 ± 7 (7 – 26) and 12 ng/g wet weight. Although the Hg concentration in edible tissues of economic aquatic animals in the SKL do not yet exceed a maximum residue limit as recommended by the World Health Organization (WHO) and the Ministry of Public Health of Thailand (500 ng/g wet weight), the frequent consumption of Hg contaminated fishes and shrimps in the SKL may pose a health risk to consumers.

Phylogenetic relationships among Thai newts assessed using mitochondrial DNA sequences

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Seventeen individuals of the Himalayan newt (*Tylototriton verrucosus),* which are amphibians in the Order Caudata (Urodela), Family Salamandridae, representing 6 populations from Northern and Northeastern mountain ranges in Thailand were examined for mitochondrial DNA sequence variation in the 16S ribosomal RNA gene and D-loop. Molecular data support the existence of 2 types of Himalayan newts. The 2 types of this taxon can be distinguished by the color patterns of body parts, limbs and tails. Type I, characterized by orange to yellow body coloration, is distributed in Northern mountain ranges, and Type II, characterized by relatively dull body coloration, is distributed in Northeastern mountain ranges. In addition, the distributions and ecological data of these newts are updated and discussed. These data could be useful for further taxonomic evaluation and conservation of this animal in the future.

Molecular cloning of antimicrobial-peptide genes from frogs in the family Ranidae in Thailand

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Antimicrobial peptides (AMPs) are part of the innate immunity found in virtually all organisms as diverse as bacteria, plants and animals and including humans. AMPs can inhibit or kill various microorganisms such as bacteria, viruses and parasites. Most AMPs work by disrupting cell membranes. Thus the mechanism is non-specific to species of microorganisms. Therefore, AMPs could be used as broad-spectrum antibiotics especially in cases of multi-drug resistant pathogens which have become a major problem in medical care. Frogs have been known to secrete many bio-active compounds, including toxins, neuropeptides and AMPs, onto their skin. It has been estimated that one species of frog may have up to 20 different kinds of AMPs. Since Thailand has approximately 80 species of frogs, 1600 AMPs could exist in nature. This natural resource has not been investigated and utilized before. Therefore, we plan to clone genes that specify antimicrobial peptides, which is the first step for utilization of this valuable and rich resource. The cloned gene will be used for production of therapeutic proteins by the *Molecular Farming* method in the future.

Microhabitat use by the Median-striped Bullfrog, *Kaloula mediolineata*, in Tak Province, Thailand

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The Median-striped Bullfrog, *Kaloula mediolineata*, is a burrowing ground dwelling anuran. This species is widely distributed in North-Eastern, South-Eastern and Central parts through to Prachuap Kiri Khan. They have been exploited as food in the North-Eastern part of Thailand. For long-term conservation and utilization, culture and frog farming is necessary. The purpose of this study is to conduct a survey on vertical dispersion and physical characteristics of the burrowing position of *K. mediolineata*. The study was conducted in secondary forest in Tak Province during September and November, 2004, and July and August in 2006. Field observations indicated that individual vertical dispersion patterns were related to monthly rainfall. Depth of frog holes in the rainy season (July, August and September) was less than hole depth in the dry season (November) (t-test, $p<0.05$). Soil temperature at the burrowing site was lower than that of the surface soil (t-test, $p<0.05$). Soil samples collected in 2004 indicated that the texture of surface soil was sandy loam, while soil at the burrowing location was loamy sand. Soil moisture of both positions collected in 2006 was not significantly different.

Seasonal activity of amphibians at different elevations along Nam San Noi Stream, Phu Luang Wildlife Sanctuary

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Field work was conducted at Nam San Noi Stream, Phu Luang Wildlife Sanctuary, from May 2006 to March 2007. Three 100 m stream transects at 700, 800, 950, and 1300 m above MSL were selected as study sites. Visual encounter surveys were conducted every month along each transect at night. Species and numbers of adults found in each survey were recorded. A total of 23 species was recorded during the survey period. Seven species, *Leptolalax pelodytoides, Fejervarya limnocharis, Limnonectes kuhlii, L. pileatus, Rana livida* (from1), *R. nigrovittata,* and *Polypedates leucomystax,* were found throughout the year. The numbers and breeding activity of *R. livida* (from1) and *R. livida* (from2) were high during the rainy season whereas in *Limnonectes kuhlii, L. pileatus,* and *Microhylar berdmorei* these variables were high during the late rainy season to early dry season. In contrast, the number and breeding activity of *R. nigrovittata* peaked in the dry season. The patterns of occurrence of the other 11 species could not be evaluated due to the number of individuals found being too low. The effect of elevation on the abundances and distributions of frogs is under investigation.

Appraisal of the evolution of testudinoid turtle diversity from the Late Palaeogene and Neogene of Thailand

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The evolution of turtles in the superfamily Testudinoidea in Thailand was assessed by using both the fossil record and information about recent turtles. For appraising the systematic position of fossil turtles, a catalogue of the osteology of Thai testudinoid turtles was constituted. The osteology of Thai testudinoid turtles is illustrated for each species. Keys for shell characters are also provided. Two localities were selected for studying fossil turtles, Nong Ya Plong, Petchaburi Province, and Tha Chang Sandpits, Nakhon Ratchasima Province. The turtles from the first locality were identified as two new taxa; a new species of *Mauremys* and a new genus closely related to *Malayemys*. The turtles from the second locality were identified as giant testudinid turtles. Living genera of turtles before the late Neogene have not been found, including in this study. Five biogeographical provinces were obtained by using the geographical distributions of turtles in the superfamily Testudinoidea and by using clustering methods for separating areas based on similarity of taxa. These provinces were then integrated with a published phylogeny. It was found that *Heosemys* group is endemic to an Indochinese Province. In addition, the turtles in Thailand are more related to Indonesian Province turtles than to turtles in India and China. However, fossil turtle evidence of the *Heosemys* group has not been found before the Pliocene or Pleistocene turtles from Khok Sung, Nakhon Ratchasima Province. This means that the biogeographical identity of living turtles in Southeast Asia began recently.

Radio-telemetry study of home range size and activities of the black giant tortoise *Manouria emys phayrei* (Blyth, 1853)

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The objective of this study is to determine the activity, habitat use, diets and home range size of the black giant tortoise, *Manouria emy phayrei,* in Kaeng Krachan National Park, Thailand. Data were collected from November 2005 to May 2007. Ten *M. emys phayrei* were radio-tracked, including seven adults and three subadults. Preliminary results suggested that *M. emys phayrei* had different habitat requirements for different activities (e.g, feeding and hiding). Five different types of habitats were utilized: bamboo forest, dry evergreen forest, dry evergreen forest mixed with bamboo, streams and damp or wet areas. In the rainy season (May-October), many tortoises were found foraging in the bamboo forest whereas in the hot dry season (March-April) they were frequently found near streams or in damp areas. During the coldest months (November – February), a few tortoises were active and were commonly found under fallen branches or leaf litter. *M. emys phayrei* fed on a variety of plant species. Forty-nine diet samples were collected from 13 different plant species. *Zingiber* sp. and *Bambusa* sp. were the main diet in the dry season and wet season, respectively. Preliminary results on home range size indicate that adults tend to have home range sizes larger than subadults.

Minute theropod eggs and embryos from the Lower Cretaceous of Thailand and the dinosaur-bird transition

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We report on very small fossil eggs from the Lower Cretaceous of Thailand, one of them containing a theropod embryo, which display a remarkable mosaic of characters. While the surficial ornamentation is typical of non-avian saurischian dinosaurs, the three-layered prismatic structure of the eggshell is currently known only in extant and fossil eggs associated with birds. These eggs, about the size of a goldfinch's, mirror, at the reproductive level, the retention of small body size that was paramount in the transition from non-avian theropods to birds. The egglayer may have been a small feathered theropod similar to those recently found in China.

Life history patterns of homalopsine snakes inside and outside the Khorat Basin, Thailand

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The purpose of this study is to compare life history patterns of homalopsine snakes inside and outside the Khorat Basin. Snakes were trapped by gill nets at two locations, Ban Badan, Nakhon Ratchasima Province (inside Khorat Basin) and Kabinburi District, Prachinburi Province (outside Khorat Basin), from April 2006 to March 2007. Five species of homalopsine snakes, *Enhydris enhydris*, *E. plumbea*, *E. subtaeniatus*, *E. boucourti* and *Homalopsis buccata*, were caught. *Enhydris enhydris*, *E. plumbea* and *Homalopsis buccata*, were found in both study sites whereas *E. subtaeniatus* was found only at Ban Badan and *E. boucourti* was found only at Kabin Buri District. Stomach investigation showed that homalpsine snakes inside and outside the Khorat Basin feed mainly on fish such as cyprinids, anabatids and belonids. Nevertheless, *E. plumbea* from Ban Badan was found to feed on burrowing frogs, *Kaloula pulchra*, and freshwater eels, *Anguilla alba*. Gravid females of *Enhydris enhydris*, carrying 25 to 37 embryos, were found only in April and June at Ban Badan whereas at Kabinburi District they were found throughout the year with the highest peak from April to July. In addition, three other semi-aquatic species, *Xenochrophis flavipunctatus*, *Xenopeltis unicolor* and *Cylindrophis ruffus*, were caught by gill nets at both study sites.

Food habits and nesting behavior of the collared scops owl (*Otus bakkamoena* Pennant) in Chanthaburi Province

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Since information on the ecology of the collared scops owl in Thailand is extremely limited, this study thus attempts to develop an understanding of their basic ecology concerning food habits, nesting ecology and behaviour including nest site selection. Owl nests were searched for and located using GPS. Habitat descriptions, *i.e.*, plant structure and composition, at each nesting site were characterized by establishing a 10-m radius circular plot. Owl pellets and food debris were collected and analyzed to identifiy the type and amount of food. From August 2006 - September 2007, 23 nests were found and observed in Chantaburi province. The results showed that the collared scops owl started their breeding season from early February to the end of April. The numbers of layed eggs were 1- 4 eggs / nest (2.81 ± 1.60) and the hatching rate was 61.37 %. The average weight of hatched chicks was 12.8 ± 1.6 g. Females tended to choose tree holes with openings on the top. The average nest height was 2.77 ± 2.20 m from the ground. Food habits and nest site selection data were collected and are now in the process of analysis.

Effects of food supply on foraging patterns and weights of wintering shorebirds on a managed wetland in the Inner Gulf of Thailand

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This study was conducted at the Laem Phak Bia Environmental Research and Development Project, Phetchaburi province. Variation in food availability for shorebirds was monitored to determine whether it affected shorebird prey capture rates, chasing rates, pace rates, and body weight of Long-toed Stints. Comparisons were made to examine the differences between juvenile and adult shorebirds' prey capture rates, pace rates, and body weights. Invertebrate sampling**,** shorebird counting**,** foraging observations**,** and catching shorebirds were carried out during August 2006-April 2007. A total of 49 Long-toed Stints were caught and individually colour marked. The results of invertebrate sampling showed that *Chironomid* larvae were the most abundant invertebrates in the study plot and they were more abundant in autumn (August 2006-October 2007) than winter (November 2006-February 2007). Long-toed Stints were also heavier in autumn than winter suggesting a link between food abundantce and body weight. This may indicate that the quality of the wetland is important to the health of Long-toed Stints and other shorebird species.

Bird diversity in grassland at Tung Salang Luang National Park

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A survey of grassland bird diversity was carried out at Tung Salang Luang National Park at 2 study sites, i.e., grassland savannah and grassland - mixed coniferous forest. The point count and line transect methods were used for data collection (Ralph et al., 1997) and was done once a month in 3 periods, for a year. The survey revealed 1,889 birds from 84 species, 32 families, and 11 orders occurring at both sites. Birds found in grassland savanna comprised 871 individuals from 62 species and 26 families in 10 orders and in grassland - mixed coniferous forest comprised 1018 individuals from 56 species and 27 families in 9 orders. Birds were classified into 6 groups based on feeding strategies, *viz.* carnivorous, frugivorous, omnivorous, insectivorous, nectarivorous, and gramnivorous birds. The highest percentage of species found was 45-46% for insectivorous birds and the fewest was 3-4% for nectarivorous birds. Similarity, using Sorensen's index, of bird species between both sites was 58%. However, values of the similarity index for insectivorous and nectarivorous birds between both sites were 70% and 100%, respectively Dominant bird species in 2 sites were determined using the highest frequency values, densities, and abundances. Four species, *viz.* *Streptopelia orientalis* (Oriental Turtle-Dove), *Pynonotus aurigaster* (Sooty-headed Bulbul), *Prinia hodgsonii* (Grey-breasted Prinia), and *Prinia rufescens* (Rufescent Prinia), were co-dominant species in both grassland sites. The results show that co-dominant, insectivorous, and nectarivorous birds are indicators of individual characteristics of grasslands in the area.

A study of genetic diversity of the roundleaf bat (*Hipposideros halophyllus*) in Thailand, a Thai endemic mammal

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The Thailand roundleaf bat (*Hipposideros halophyllus*), a Thai endemic mammal, has been locally categorized as an ENDANGERED species. There are currently known to be three free-living populations of *H. halophyllus* at least over 130 km apart from each other, which are located in Hui Khakhaeng wildlife sanctuary-Uthai Thani province, Khoa Samo Khon-Lop Buri province, and Khao Singto-Sa Kaeo province. The great distances between populations likely prevent gene flow among these three populations. Therefore, we hypothesized decreasing genetic variation among and within the populations would be expected. The main objective is to test the hypothesis of low genetic diversity among and within the 3 populations of *H. halophyllus* by using microsatellite markers. The first field work was conducted during 10-16 June 2007 at Khao SamoKhon, Lop Buri province, a habitat with the largest colonies of *H. hallophyllus*. We collected tissue samples from wing membranes using 4-mm diameter wing punches. The tissues were kept in 1.5-ml Eppendof tubes each containing 0.5 ml. of 95% EtOH, stored at room temperature in the field and at 4^{o}C in the freezer at the laboratory. We sampled a total of 79 individuals (40 adult males and 39 adult females) of *H. halophyllus* from three caves. DNA was isolated from the first two tissue samples and tested for its quality and quantity. We obtained a sufficient amount of DNA of good quality for PCR analysis. Additional results and data analysis will be reported and discussed.

Survey and preparation of a guide to natural resources in Khao Samo Khon, Amphoe Tha Wung, Changwat Lop Buri

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Khao Samo Khon is an important archaeological site and a substantial habitat of the Thailand roundleaf bat (*Hipposideros halophyllus*), a Thai endemic and locally endangered species, located in Tha Wung, Lop Buri province. This area is home to the largest colonies of *H. hallophyllus*. The landscape is remarkably attractive and is considered to have high potential for recreation, especially for ecotourism. Ecotourism, a knowledge-based recreation, requires scientific information of natural and cultural resources in the area, which has never been documented before. The main objectives of the project are to prepare learning materials and to educate local people about their natural resources. Our study team consists of three wildlife specialists, two botanists, two invertebrate specialists, and three technicians. The first study was conducted during 24-28 May, 2007. Our results revealed that organism diversity consists of at least 14 families with 24 species of mammals, 38 families with 78 species of birds, 7 families with 11 species of reptiles, 3 families with 4 species of amphibians, 1**7** families with **65** species of insects, and 53 families with 113 species of plants. Significant organisms consisted of *H. hallophyllus*, two rare species of plants, namely *Ehretia winitii* Craib and *Marcania grandiflora* Imlay, and two new records of species of plants in central Thailand, namely *Jusminum siamensis* Craib, and *Jusminum funale* Decne. subsp. *sootepensis* (Craib). In addition, we conducted 2-day natural science camps at the study site. The camp was attended by 65 students and 10 teachers from two local primary schools.