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บทคัดย่อ

โครงการวิจัยและวิทยานิพนธ์ 2552

การประชุมวิชาการประจำปีโครงการ BRT ครั้งที่ 13

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โครงการพัฒนาองค์ความรู้และศึกษานโยบาย

การจัดการทรัพยากรชีวภาพในประเทศไทย

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BRT
The Thai Response to Biodiversity

Rice landrace diversity and community conservation in northeastern Thailand

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The objectives of this research study are to further understand the knowledge and role of peasants towards conservation of rice landraces in northeastern Thailand, to evaluate rice landrace diversity using agro-morphological traits and molecular genetic diversity, and to map their distribution using GIS. Preliminary results showed that the knowledge and role of peasants in conservation of rice landraces was dependent on the ecological system, and the socio-cultural and economic conditions of each community. Our ongoing research activities include evaluation of rice landrace diversity using agro-morphological traits and molecular genetic diversity, and analysis of their geographic distribution.

Bamboo shoot steam processing by the Tha Sao community, Sai Yoke district, Kanchanaburi province

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Bamboo shoots (*Thyrsostachys siamensis* Gamble) are one of the valuable plant products which can be gathered in large amounts during the rainy season. Tha Soa villagers gather the bamboo shoots for domestic consumption and pack the surplus in plastic for the steaming process. The researcher aware of its danger studied the production of steamed bamboo shoots of Tha Sao community. After analysis the quality of steamed bamboo shoots in terms of physical, chemical and biological characters was determined. The findings of the research showed that effective steaming for preserving the quality of steamed bamboo shoots for over 120 days had the following procedure: 1) peel and remove the shoot skins, and clean with water, and 2) steam the bamboo shoots by using a three layered steaming pot, with the second storey left vacant to prevent the shoots from contacting the boiling water. The steaming (100°C) took 15-30 minutes. After that the bamboo shoots were taken from the boiling water, wrapped with two layers of plastic bags, and hung at room temperature.

Analysis of the product's quality was performed and the product was compared with the community's product atandards. It was found that, in terms of physical analysis, contamination, general features, odor, taste, and texture were at standard levels. In terms of chemical analysis, the pH ranged from 5.58-5.98 and the lead level ranged from 0.047-0.476 mg/kg, which were not above the standard levels. In terms of biological analysis, microbes were found to be less than 10 cfu, which is not over the standard level, when the shoots were kept for 120 days.

Cost management and complete production value evaluation of bamboo products to bring permanent development to Tumbol Tha Sao, Sai Yoke district, Kanchanaburi province

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The objectives of the research were: (1) to study the production costs; (2) to determine problems of production cost management; (3) to present directions for production cost management; and (4) to evaluate the complete production value of bamboo products. Sampling groups of this study were four bamboo product producers who produced widemounted bamboo baskets, boiled bamboo shoots for a factory, boiled bamboo shoots contained in kerosene cans, and streamed bamboo contained in plastic bags. The research instrument was the interview method. To analyze data, the research used descriptive analysis and quantitative methods. The research results were as follows. (1) The production cost of each product: 1.1) the total cost per unit of widemounted bamboo baskets was 37.69 Baht per piece: 1.2) the total cost per unit of boiled bamboo shoots for a factory was 7.53 Baht per kilogram; 1.3) the total cost per unit of boiled bamboo shoots contained in kerosene cans was 190.55 Baht per kerosene can; and 1.4) the total cost per unit of steamed bamboo shoots contained in plastic bags was 8.26 Baht per bag. (2) The problems of production cost management of the four bamboo products were from variable costs especially the direct material cost. (3) The researcher presented directions for managing the production cost of bamboo products as follows: 3.1) production cost reduction as 3.2) increment in production. (4) Production value of the four bamboo products were 16,444,500 Baht per year.

The relationship between bamboo and the household economy at Tha Sao, Sai Yoke district, Kanchanaburi province

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This research was done to study the relationship between bamboo and the household economy. The results of this study will be used as fundamental information to encourage and preserve bamboo cultivation. The method used in this study was a qualitative method. The sampling groups were three household groups. Considering the revenue of 30 households who had weaved bamboo baskets in the three communities, revenue coming from bamboo basket weaving was highest. The common revenue was the second highest revenue and specific revenue was the lowest revenue. The percentages of the three kinds of revenue were 66.84, 30.20, and 2.96%, respectively. The number of bamboo baskets was 98,443 pieces and the number of bamboo trees used in bamboo basket weaving was 147,665. It indicated that the use of bamboo had a close relationship to the household economy. Regarding the use of bamboo by people who had wickerwork as their career in the three communities from Tha Sao community, revenue coming from bamboo basket weaving was 7,392,058 Baht, the quantity of bamboo baskets was 276,038 pieces, and the number of bamboo trees used for this purpose was 414,058. In terms of the relationship of bamboo to daily life, every household gained a high benefit from bamboo. They used bamboo for cooking both for foods and desserts, for house construction, fences, and pens, for household equipment, and for agricultural tools. Bamboo can possibly be claimed to generate revenue for households and to bring benefits to the daily life of the countryman.

Economic and capital analysis of planted bamboo in Tumbon Tha Sao, Sai Yoke district, Kanchanaburi province

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This research aimed to study the state of general bamboo farming in Tumbon Tha Sao, Sai Yoke, Kanchanaburi. The average cost per rai, revenue, annual cost, financial return rate, break-even point and return on investment period were analyzed. A constructed questionnaire was used as the research equipment to collect data. The data on average cost, financial return rate, return on investment period, the cost of bamboo farming, break-even point, and the average financial return rate were analyzed using financial and accounting formulae. The research findings revealed that 12 farmers with 81 rai grew bamboo, most of which were pai ruak, as an additional job for commercial purposes and for household use. The results indicated that the average cost was 1,204.25 baht per rai. The income from selling bamboo shoots and stems was 1,483.89 per rai. The average annual cost was 256.15 per rai, but the average financial return in 2008 was 80.89%, with an average break-even point of 22.52 kilogram or 126.35 baht. The average financial return period was 1 year and 8 months. The research results can be practically put to use. The findings suggested that bamboo farming should be promoted to augment farmers' incomes. The financial return rate is interesting and the cost per rai is not much, with a quick financial return.

Screening of phosphate solubilizing bacteria from the bamboo rhizosphere in Pu-Teuy community forest, Thailand

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This research aims to screen phosphate solubilizing bacteria in the bamboo rhizosphere. Soil samples were taken from 8 types of bamboo, *Cephalostachyum pergracile* Munro, *Gigantochloa albociliata* (Munro) Kurz, *Thyrsostachys siamensis* Gamble, *Gigantochloa densa*, *Dendrocalamus strictus* Nees, *Bambosa bambos* L. Voss, *Dendrocalamus membranaceus* Munro and Plong-Yaw bamboo in Pu-Teuy community forest, Sai Yoke district, Kanchanaburi province, Thailand. The soils were analyzed for chemical and biological characteristics. The results showed that the soils were low in moisture (13.63%), had a neutral pH (pH 7.72), were low in total phosphate (1372.05 ppm) and very low in soluble phosphate (224.14 ppm). Phosphate solubilizing bacteria were obtained from 16 isolates and there was 1 isolate of yeast. The bacteria giving the best phosphate solubilization activity were *Pseudomonas aeruginosa* from *Thyrsostachys siamensis* Gamble, *Burkholderia pyrrocinia* from *Gigantochloa albociliata* (Munro) Kurz, *Burkholderia cepacia* from Plong-Yaw bamboo and *Cedecea neteri* from *Cephalostachyum pergracile* Munro, respectively. The remaining isolates from other bamboos could not be identified because they could not be grown for a long enough time under laboratory conditions.

Knowledge management of bamboo utilization by local wisdom in Tambon Tha Sao, Sai Yoke district, Kanchanaburi province

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This qualitative research focused on a participatory process to investigate the local wisdom of bamboo propagation, cultivation, nurturing, harvesting, storage, utilization and culture related to bamboo, and to study how this local wisdom was transferred. Sixteen types of bamboo were found in the study area: *Bambusa bambos* (L.) Voss, *Gigantochloa albociliata, Gigantochloa densa, Cephalostachyum pergracile, Dendrocalamus membranaceus*, *Thyrsostachys siamensis*, *Dendrocalamus asper*, *Bambusa nutans*, *Melocalamus compactiflorus (*Kurz*)* Benth., *Bambusa burmanica* Gamble, *Bambusa vulgaris* Shrader ex H. Wendland, *Dendrocalamus copelandii* (Gamble) ex Brandi, *Dendrocalamus strictus* (Roxb.) Nees, *Dinochloa* sp. and 2 species were unidentified, that is. Phai Lam-Ruerg and Phai Plong-yao. There were five methods of bamboo propagation including from seed, new shoots, culms, and rhizomes, and from tissue culture. Good cultivation required proper spaces between rows. Natural fertilizer and pruning were required for nurturing. Proper harvesting is used for the better quality of bamboo products. There were two storage methods for bamboo: food processing for bamboo shoots, and storage in shade for culms. There were seven purposes for utilizing bamboo: food, medicine, pest control, construction material, tools, local traditional material, and part of ecology. Bamboos were used to cut newborn umbilical cords, make rafts for the Mon Loy-Kra-Tong festival and the bamboo sticky-rice festival. They are now used as materials for different purposes in local ceremonies. The most important source of transference is the family. Telling, demonstrating, practicing, stealthy observation and observation are the main ways used for local wisdom transference. The making of bamboo baskets, bamboo sticky rice and dishes of bamboo shoots showed the most local wisdom transference.

Historical background of Sai Yoke community: A case of Tha Sao community

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This historical research concentrated on 2 purposes: first, to study the origin of the Tha Sao Community in the old days and it's development up till now; second, to study the indigenous ways of life and culture of the old days and their development up till now. The methods employed in this study were: the gathering of relevant data from documents, followed by field surveys and interviews of key informants. The focus group discussion was adopted to ensure that important data were completely collected. Data synthesis was also done and conclusions were finally made. The findings follow. Sai Yoke community especially Tha Sao community apparently began in 1947. Small numbers of people lived in this area comprising Mons, Karens and Khamus. After the end of World War II pioneer immigrants began to move in from very near areas such as Ayuthaya, Ratchaburi, Samutsongkram and even from Bangkok and from the northeast such as from Surin and Burirum. Another main group of immigrants was from Umphur Thamuang, Umphur Thamaka and Umphur Muang of Kanchanaburi.

In 1967, road number 323 was starting to be built and it became the main route for immigrants to move in, and so the number of communities increased. Now there are 11 communities in Tambon Tha Sao. Because immigrants came from various places, so their lives and livings were different but they could live in harmony because of the people being Buddhists. Their communities have been growing peacefully up till now.

Assessment of appropriate tourism programs for Tambon Huai Khayeng, Thong Pha Phum district, Kanchanaburi province

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Tambon Huai Khayeng is a natural area. In the past, it has been used for the tourism business but it was not successful. This study aimed to investigate the past failures of tourism management, to assess appropriate tourism programs and provide recommendations. Interviews and questionnaires were employed for collecting data from various sample groups, and analyzed by a weighted score method.

Results of the study indicated that causes of past failures were a lack of knowledge and understanding of the tourism business, members who did not follow the rules and regulations, conflict with administration and monopoly of tourism companies. In terms of appropriateness of past tourism programs and market factors, both tourism programs had a middle level of appropriate scores. Appropriate tourism programs of Tambon Huai Khayeng were judged by four factors, namely, potential of tourism areas, potential of community tourism management, appropriateness of tourism programs and results from meetings of past tourism business leaders. The results showed that there were two choices for appropriate tourism programs of Tambon Huai Khayeng, the first is a program for letting tourists view queen crabs and the second is showing tourists the cave. In addition, tourists can choose a one-day trip for both tourism programs.

Recommendations from this study are that there be a better understanding of the tourism business system, and that rules and regulations be followed when doing work. Unity and cooperation of the community are necessary for success.

The way of life and the use of biodiversity by local people of the Than Prasart River

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The way of life and the use of biodiversity by local people of the Than Prasart River is being observed from January to December 2009. In the first 6 months (January – June 2009), the diversity of shrimps, crabs, mollusks, fish and aquatic plants were studied. There were a total of sixteen species of macroinvertebrate found that belonged to 3 families and 3 genera. Likewise, twenty-two species of fish that belonged to 15 families and 22 genera and 42 species of aquatic plants belonging to 24 families and 35 genera were found. The survey of biodiversity indicated that biodiversity has a firm relationship to the way of life of local people. They have used many species of animals and aquatic plants for food, handicrafts and rites for a long time from past to present.

Utilization and conservation of wild plant diversity: A case study of Karang Village in Kaeng Krachan National Park

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In this case study we focus on the Karang Village in Kaeng Krachan National Park. We look at the development and varieties of wild plants grown by these people, trying to gain a better understanding of the situation, in particular, the factors that affect the decisions of households or the actual community and, in additional, make suggestions about the roles of people in the communities and villages in conservation of agricultural and home gardens.

Qualitative and quantitative methods were used to gather information in Ban Pong Luek and Ban Bang Kloy Village at Kaeng Krachan National Park during April to May, 2009. We decided to use a head of a family or a suitable person over twenty years of age; this data was then to be forwarded to an agent selected from the household, also fitting the criteria. Population samples in Ban Pong Luek comprised 65 households whereas 71 households were sampled in Ban Bang Kloy. Techniques employed were questionnaires and logs of the varieties of species, and key informants were interviewed. This data was analyzed using the computer program, SPSS for windows. We then investigate the diversities of wild plants by the Shannon-Wiener Index (H).

Ultimately this research will provide us with all biological varieties. We can then help educate other societies, thus creating a stable food supply and a better ecosystem in the future.

Current knowledge on the potential of Thai plants for plant and animal pest control

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An investigation of indigenous knowledge and current research literature on Thai plants tested against plant and animal pests was made on 298 species of plants. The study covered the effects of these plants on insect and animal pests, phytophathogens, food spoilage microbes, crop and weed emergence and growth, and toxic effects on beneficial animals and the environment wherever possible. Results of this study revealed that 69 plant species have high potential with a wide spectrum of control of plant and animal pests. Plant descriptions, other beneficial uses, phytochemistry and potential for pest control of these plants were described in detail. The remaining 156 plant species which showed some potential for controlling specific pests with a narrow spectrum and the other 73 plant species in which preliminary tests showed no effects on tested pests were also recorded in this report.

Adaptation to a new sub-montane habitat by a lowland species, the Siamese fireback, in Khao Yai National Park, Thailand

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One consequence of global climate change relates to elevational range shifts within and among wildlife communities, particularly lowland species shifting to higher elevations. However, the response of vertebrates to these changing habitats at higher elevations has been poorly documented. Here we investigated the habitat use of a lowland species, the Siamese fireback, which is expanding its range into sub-montane habitat as a consequence of climate change in Khao Yai National Park, northeastern Thailand. Our results show that the Siamese fireback tends to use topographically flat areas, similar to the topography found in lower elevation habitats. However, nest site locations were found on steeper slopes, presumably to facilitate predator detection and escape. Moreover, these birds also selected areas with higher under-story cover during the mating season as reported in lowland populations. We also found that females move to areas with higher densities of ground vegetation while rearing young chicks. Overall, we conclude that the Siamese fireback are adapting to their new, perhaps modified, sub-montane habitat.

Diet analyses of the Red-headed Trogon and the Orange-breasted Trogon in relation to seasonal arthropod abundance and avian phenology

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A large amount of data has already been collected on the ecology of bird species at the Mo-Singto plot, Khao Yai, a 30 ha long term biodiversity plot, including data on breeding and moult observations. Round et al. (2005) found little correlation of the seasonality of breeding and moult at the Mo-Singto plot with either rainfall or fruit abundance. They suggested, as have other studies (e.g., Poulin et al. 1992), that arthropod abundance is a crucial factor governing the timing of breeding. To investigate this hypothesis, two similar insectivorous species have been focused on, namely the Red-headed Trogon, *Harpactes erythrocephalus***,** and the Orange-breasted Trogon, *Harpactes oreskios.* Information has been collected on the composition of arthropods in the two species' diets and relevant arthropods have been sampled to allow comparisons of prey abundances to be made between the two bird species.

The use of tree-fall gaps by a forest interior avian frugivore

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Early studies suggested that frugivorous birds foraged more in forest gaps than forest interior sites because gaps provided greater food resources. However, recent studies suggest that the relationship between frugivorous birds, fruit resources, non-fruit resources and gaps was complex and the reasons for gap use by many birds remains unclear. The objective of this study was to investigate the effect of tree-fall gaps on the behavior of the frugivorous Puff-throated Bulbul (*Alophoixus pallidus*),, a species of the forest interior. In this study, we predicted that Puff-throated Bulbuls would more likely forage in tree-fall gaps due to the greater availability of food resources and greater protection from predators due to the dense vegetation. The number of observations for all behaviors in the tree-fall gaps fluctuated during the study period. During the non-breeding season Puff-throated Bulbuls were less likely to use tree-fall gaps and 10 m buffer areas surrounding gaps, especially gap interiors where there was significantly less activity than expected based on the area occupied by gaps. Puff-throated Bulbuls more frequently use gaps and gap edges during the breeding season, with significantly more activity in gap edges. Our data suggest that gaps provide secure places due to the high vegetation density (herbaceous cover, seedlings, saplings and lianas) available for adults for roosting during the day as well as cover for fledglings during the early post fledging period, while the prediction of greater food resource use in gaps was not supported.

Survival and natal dispersal of juvenile Puff-throated Bulbuls (*Alophoixus pallidus*): a cooperatively breeding species

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Tropical passerines are expected to have a more complex life history than those in temperate zones. It is predicted that cooperative breeding species would have higher juvenile survival rates because of prolonged parental care. Natal dispersal can have a significant impact on population dynamics particularly for cooperative breeders. These demographic parameters are rarely demonstrated and typically difficult to quantify in the tropics. We modelled probabilities of fledgling Puff-throated Bulbuls (*Alophoixus pallidus*) surviving the dependent period of parental care (for birds hatched in 2006-2008). After independence, we modelled probabilities of staying in the natal territory and the timing of dispersal. The probability that a fledgling survived to independence was 61%, and did not vary among years, sexes, or the presence/absence of helper(s). The most critical time was during the first week after leaving the nest, which is typical for most birds. Juveniles did not disperse until the second calendar year. Dispersal was strongly female-biased both in frequency and distance. Ninety-five percent of females dispersed, crossing 2-7 territories, while 50% of the males were philopatric, and half of the dispersing males moved to neighbouring territories. Understanding factors influencing post-fledgling survival and dispersal provides insights into these limiting life history stages which are typically characterized by high adult and juvenile survival and delayed dispersal, and which impact population dynamics. Our report on survivorship and sex-biased dispersal add to the body of evidence that life history traits of tropical passerines generally include higher survivorship, extended parental care, and delayed dispersal. Furthermore, it suggests that there is a range of complex behaviours among cooperatively breeding birds.

Estimation of species richness of small carnivores using photographic capture-recapture

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Species richness is the most widely used biodiversity measurement. However, it is difficult to observe directly as some fraction of species will always be overlooked. To derive unbiased species-richness estimates, an estimate of the species present but not detected is needed. Species richness of small mammalian carnivores (≤ 15 kg) between 2 forest types, semi-evergreen forest (SEF) and mixed deciduous forest (MDF)/savannah of Thung Yai Naresuan Wildlife Sanctuary (TY) were examined using camera trap surveys between Nov 2007 and August 2008. Detection – no detection data for eleven species detected during the survey of both forest types and overall (forest types combined) were arranged in a row–column matrix to account for false absence of species. The program CAPTURE under model Mh, which accounts for heterogeneity of species detection probabilities, estimated the overall small carnivore species richness as being between 12 – 22 species. Slightly higher richness was estimated for MDF (12 – 30 species), whereas the estimate derived for SEF lacked precision possibly due to the low number of detections where they were present. The overall species richness estimates appeared to be relatively accurate when compared to the known numbers of small carnivore species believed to occur in the area (20 species; Lekagul & McNeely, 1997). However, to increase the accuracy of estimates, enhancement of survey methods to improve species detection rates will be implemented using a combination of baits including both plant and animal materials, e.g., canned fish and ripe fruit, at camera trap stations to attract species with different food habits (meat–, fruit– oriented) as proven effective elsewhere.

Micro-habitat use of the Bengal slow loris, *Nycticebus bengalensis,* in Khao Ang Runai Wildlife Sanctuary: Preliminary results

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While the area of primary tropical forest is considerably reduced globally and much of the remaining area is seriously degraded, the extent of planted forests is increasing but has generally been thought to have limited value for wildlife conservation. In this study we examined micro-habitat selection of a nocturnal arboreal primate, the Bengal slow loris (*Nycticebus bengalensis*), in primary forest, 18-yr old plantation with succession, and young plantation habitat at two levels, tree and within adjacent area. Based on 75 used trees found during November 2007 - December 2008 and 204 random trees, the slow loris strongly preferred using taller trees with deeper crowns ($P < 0.0001$), whereas the presence of *N. bengalensis* at microhabitat scale, in areas adjacent to used and random trees, is associated with stem size and negatively to the numbers of poorly-connected crowns, suggesting that simplified habitat, such as young plantations where lowest crown connectivity is common, appeared to be the least suitable habitat for this nocturnal arboreal primate. These results emphasize the importance of maintaining primary forest for biodiversity. However, with proper management, particularly by minimizing human hunting pressure, older plantations may have significant conservation value.

The density of the Bengal slow loris, *Nycticebus bengalensis*, in primary and regenerating habitat in Khao Ang Rue Nai Wildlife Sanctuary: Preliminary results

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Even though other Asian nocturnal primates have long been studied, little is still known on the ecology of Slow Lorises (*Nycticebus* spp.), small cryptic strepsirrhines with a nocturnal life style. The Bengal slow loris (*Nycticebus bengalensis*) is currently listed as CITES Appendix I and as a Data Deficient (IUCN 2000) species, which indicates the crucial need of knowledge to preserve the species. During November 2007-December 2008, a systematic survey was started in Khao Ang Rue Nai Wildlife Sanctuary aiming to define loris density in three different areas, i.e., primary habitat, old plantation with succession, and young plantation. Four transects were laid over one, 14 km dirt road (cut through different habitats from marginal to the core area). A total of 116 lorises were observed in 103 detections during 212.6 km of transect surveys on 77 nights. The highest loris encounter rate was observed in old plantation with successional habitat, at 1 loris/km, followed by 0.36 loris/km in primary forest, 0.45 loris/km in plantation, and the lowest encounter rate of 0.37 loris/km was in open habitat. Nevertheless, a standardized technique, distance sampling, proved that the difference between primary forest and old plantation is only a sequence of unequal detectability. However, both simple and standard techniques indicated that the lowest slow loris abundance was in young plantation which was presumably least suitable for this nocturnal arboreal primate.

Seed dispersal by pileated gibbons at Khao Ang Rue Nai Wildlife Sanctuary

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Seed dispersal is an essential part of tropical rainforest regeneration which supports the idea that frugivores are vital to the survival of fruiting tree populations and the maintenance of tropical forest dynamics and diversity. Gibbons are frugivorous and, so, potentially play an important role in the dispersal of seeds of trees and lianas in the forest. They are long-distance dispersers, transporting seeds away from the parent source. An intensive study of seed dispersal by the pileated gibbon was conducted on one habituated gibbon group at Khao Ang Rue Nai Wildlife Sanctuary (KARNWS), Southeast Thailand. The target group was followed from night tree to night tree to investigate their feeding ecology and behavior. The results showed the annual home range size of the study group was 56 ha by MCP. When calculated by the 95% and 50% Kernel method, the size of the home range of the gibbons for the whole year was 52 ha and 6 ha respectively. They traveled 1,398 m per day on average. We classified gibbon food into 4 categories. Fruit is the major diet of pileated gibbons, with 78 percent of total feeding times. *Ficus* spp. consumption also comprised large amounts of their feeding time at 19 percent. Most of their fruits are colorful and have sour and/or sweet tastes. Young leaves were next in importance followed by flowers and arthropods at 18, 1, and 1 percent respectively. *Platymitra macrocarpa* Boerl. and *Ficus* spp. are important foods of the pileated gibbon in this study site because they provide fruit all year round. The information that we obtained so far is preliminary and the project research objectives will require more time to accomplish them. We will continue the part of the research concerned with seed dispersal by gibbons to understand their major role in the tropical forest and also for restoring disturbed forest (past logging) in KARNWS as an example.

Evolution of the gibbon social system

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The gibbon social system, typically consisting of socially monogamous and territorial pairs is unique among the apes. An attempt has been made to synthesis the critical selective forces shaping monogamy and territoriality in gibbons. In this synthesis a framework of three conditions are believe to be important in gibbons and suggest what empirical evidence that needs to be collected in order to verify this theory. Some evidence will be drawn from the study of social behavior, foraging and ranging behavior of white-handed gibbons (*Hylobates lar*) on the Mo Singto study plot in Khao Yai National Park, Thailand. We present the observations on the use and distribution of fruit resources within the feeding range of white-handed-gibbons. Data were obtained while following gibbon study group A for 5 or 6 days each month in 2004 and all trees and lianas fed in were recorded. All trees on the plot were previously identified, mapped and tagged. The year 2004 the tree *Nephelium melliferum* (Sapindaceae), a common species under study preferred by gibbons in April and May, fruited heavily. All data were entered into a Microsoft Access database that has the names and coordinates of all trees on the plot, and mapped with ArcView GIS. Home ranges defined by locations of fruit sources are calculated by the minimum convex polygon method using applications on ArcView. The main characteristics of most gibbon population are very small group size, a monogamous tendency, and territorial resource defense. The conditions predisposing gibbons toward this life history fall into three categories; resources homogeneously distributed within a relatively small range, i.e. a small home range is important in facilitating both easier defense and more efficient location and use of resources; high mobility of the group, i.e. small group size facilitates more rapid travel and more efficient range use; and ability to internalize benefits of resource defense, i.e. intimate knowledge of resources allows use of small and rare resources which will probably reduce interspecific competition, especially at critical times of food shortage. This set of characters is reinforced by positive feedback on selective forces that drive group size and range size to the minimum.

Daily activities of Assamese macaques (*Macaca assamensis*) at Tham Pla Temple, Chiang Rai province, Thailand

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The Assamese macaque (*Macaca assamensis*) is one of five species of monkeys in Thailand that can be found in the northern and western regions. Tham Pla Temple is a Buddhist temple located near Tham Pla Mountain in Mae Sai District. There are about 150 macaque individuals living at this site. This presentation shows the results of the study from February till July 2009, that is, only half of the proposed period. The methods of behavioral observation included qualitative and quantitative methods such as focal-scan sampling. Information on macaque individuals, activity, food type, where the animals live, nearest neighbor, and nearest neighbor distance was gathered. The macaques' behavior was observed from dawn till dusk (06.00-18.00) at 15 minute intervals. The overall activity included feeding (26%), resting (25.8%), movement (14.6%), comfort (12.8%), play (12.4%), aggression (5.2%), and sexual behavior (3.2%). The percentage of time spent at different places included on trees (36.7%), the ground (30%), on buildings (20.6%), the mountain (5.4%), the floor (4.9%), and ponds (2.5%). The daily activity data showed variation of each activity throughout the day. For example, the highest values of resting (35.6%) and play (25.1%) were at 6.00, comfort (15.3%) at 12.00, feeding (37.8%) at 13.00 and movement (24.4%) at 18.00. Since the macaques are highly provisioned by humans, therefore they performed feeding and resting for a high percentage of the time whereas movement formed a low percentage. Although they spent most of their time on trees, they also came down onto the ground to receive food. Movement was highest at dusk when they traveled up to their sleeping trees located on the mountain.

Distribution and habitat selection of the Asiatic black bear, *Ursus thibetanus*, in tropical forest, Thailand

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Wild bear populations in Thailand are threatened, but a lack of knowledge concerning the distribution and abundance of the two species found in Thai protected areas is a significant impediment to developing conservation strategies. The objective of this research was to determine habitat selection and distribution of Asiatic black bear at the national park scale. The probability of detecting bears in randomly selected plots was determined by recording presence-absence data derived from claw mark surveys across different habitat types representing most of Khao Yai National Park, central Thailand. Thirty blocks were sampled from March through December 2008. We found black bear claw marks in 24 blocks (81%), indicating that bears are widely distributed across Khao Yai, and suggesting they are not greatly affected by human activities within the park. The probability of detecting claw marks on a transect, if present, was 0.35 (SE ± 0.03). Using logistic regression, we found that fruit abundance best explained variation in the presence of black bear. We suggest using claw mark surveys for monitoring changes in black bear occupancy. Such monitoring activities are inexpensive and can be conducted by trained park rangers. Long-term conservation of large mammals, such as bears, not only requires large blocks of habitat but also knowledge of the factors that determine habitat quality. Fruits appear to be a keystone resource for *Ursus thibetanus* and factors affecting fruit abundance or shifts in seasonality (e.g., climate change) will impact Asiatic black bears accordingly.

Estimating Indo–Pacific humpback dolphin population size at Khanom, Nakhon Si Thammarat

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Indo–Pacific humpback dolphins (*Sousa chinensis*) were observed along the Khanom coastline at Nakhon Si Thammarat throughout the observation time and the year. The boat-based survey was conducted twice a month from July 2008 to June 2009 along an extensively used stretch of the coastal zone from Nang Kham Bay to Thong Ching Bay of the Khanom coastline. They were mostly found during 09.00-10.00 hr. The number of sightings varied monthly but they were mostly found in July 2008. They were encountered at water depths of 1.1-7.5 m, at distances offshore of 21-1021 m, and in water visibility of 67-256 cm. DARWIN (Digital Analysis and Recognition of Whale Image on a Network) software was used to identify individual dolphins. The population size was estimated using a Mark-Recapture Model from boat-based photo-identifications to be about 78 dolphins with a dilution rate (births and immigration) of 1.01 and a probability of survival of 0.94.

Direct seeding for restoring rainforest ecosystems in southern Thailand

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Deforestation is an urgent problem, which directly threatens biodiversity. Unsustainable use of resources causes decreased biological diversity. Although tree planting is a highly efficient way to restore forest ecosystems and their associated biodiversity, it is a relatively expensive process that requires high labour inputs. The potential advantages of direct seeding over other plantation establishment methods include cost savings associated with nursery care and planting, as well as the possibility that trees established by direct seeding may develop more naturally, and enhance the process of natural succession of the ecosystem.

Activities in this research will include the study of the phenology of tropical lowland rainforest species in Krabi and Nakhon Si Thammarat, and seed germination, seed predation and direct seeding trials in both provinces to display how differences on the west and east coasts of southern Thailand influence seed ecology and seedling performance. Also, maintenance regimes (mulching and fertilizer) will be tested at both study sites to show their effects on the level of seedling establishment success.

The main outputs from this study will include i) direct seeding techniques that can be applied immediately to improve forest restoration projects in certain areas in southern Thailand, and ii) theoretical knowledge that can be used to predict which tree species are suitable for direct seeding and to plan suitable management regimes for direct seeding in different places for restoration in southern Thailand.

Propagation and growth of rare tree species for forest restoration in northern Thailand

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This study was done to develop ways to grow rare or threatened forest tree species to include them in forest restoration programs. The research was conducted at the Forest Restoration Research Unit (FORRU) Nursery, Doi Suthep-Pui National Park, Chiang Mai province. Seeds of species, which had previously proved difficult to propagate in the nursery, were collected: *Calophyllum polyanthum* Wall. ex Choisy., *Aglaia lawii* (Wight) Sald. & Rama, *Anthocephalus chinensis* (Lmk.) A. Rich. Ex Walp., *Mesua ferrea* L., *Gardenia sootepensis* Hutch., *Scleropyrum pentandrum* (Dennst.) Mabb. and *Rothmania sootepensis* (Craib) Brem. The various treatments including a control were soaking in water for 12 and 36 hours, soaking in 80˚C water for 30 minutes, soaking in 50% sulfuric acid for 3 and 10 minutes and scarification, and were applied to increase and accelerate germination and increase germination synchrony. The experiments were repeated with each batch to determine variability among the parent trees in their response to the treatments tested depending on the likely mechanism of seed dormancy. It was found that scarification by hand was the best treatment for *Calophyllum polyanthum*, *Scleropyrum wallichianum*, and *Mesua ferrea* seeds. Their germination rates were 72%, 21.7% and 20%, respectively. The control was best for *Aglaia lawii* and *Anthocephalus chinensis*.

Molecular ecology of seed dispersal of *Ficus* spp. for forest restoration in Chiang Mai

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The framework species method of forest restoration, adapted by the Forest Restoration Research Unit (FORRU), has shown promise for restoring forest in degraded former agricultural sites. Framework tree species are native species that are easy to germinate in nurseries, fast growing, fire resilient, and attractive to seed-dispersing wildlife. *Ficus* spp. are considered as important "keystone species" used in forest restoration. Figs are available for wildlife to eat all-year-round and, by attracting wildlife, act as important seed-dispersing agents. Seed dispersers can bring in new species and/or new individuals of planted species into restored areas. In this study 7 species of figs, namely *Ficus auriculata*, *F. fistulosa*, *F. hispida*, *F. hirta* var. *hirta*, *F. hirta* var. *roxburgii*, *F. semicordata* and *F. triloba*, were collected from Doi Suthep-Pui National park, Chiang Mai (natural forest) and Ban Mae Sa Mai, Chiang Mai (forest restoration planting plots). In natural forest, 7 species of paternal fig trees were found, but in the restoration planting plots *F. hirta* and *F. hispida* seedlings were found. More than 10 primers of microsatellite markers, for example, FM 1-27, FM 3-64, FM 4-15, MFC -1, MFC -4, Frub 391, Fins N1, Fins N3, Fins I12 and Fins P8, were used to determine the paternity of fig trees in the natural forest and the seedlings in the plots. The DNA fingerprint technique was used to calculate how far seeds disperse from natural forest to plots at Ban Mae Sa Mai. The work is ongoing.

Vegetative propagation of rare tree species for forest restoration

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Forest restoration programs require production of high quality planting stock of a wide range of indigenous forest tree species. Because, many of these species have proved difficult to propagate from seed, it is important to develop methods to produce planting stock by other means. The method examined in this study was vegetative propagation of cuttings. The objectives of the research were i) to develop and test cutting propagation techniques for tree species which are rare or threatened with extirpation from northern Thailand and which have been difficult to grown from seed and ii) to test the effects of different rooting hormone treatments on cutting performance, in terms of survival, vigour, and rooting. Four rare tree species, *Haldina cordifolia* (Roxb.) Rids., *Ilex umbellulata* (Wall.) Loesn., *Rothmania sootepensis* (Craib) Brem., and *Shoutenia glomerata* King ssp. *peregrine* (Craib) Roekm. & Hart. were investigated for their suitability for vegetative propagation. All cuttings were treated with various rooting hormones and placed in the same rooting media and propagator with approximately 30% sunlight. Only 9% of *Shoutenia glomerata* produced roots. Application of auxin did not enhance rooting in other three tested species. Rooting in these species was difficult to achieve and, therefore, it is not possible to mass-produce quality planting stock in simple non-mist propagators. Further work is required to achieve good rooting by testing other propagation methods or other hormone treatments for species conservation and for forest restoration in northern Thailand.

The effects of rubber plantation-forest edges on web-building spider composition at Khuan Khao Wang forest park, Songkhla province

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Edges have been shown to produce both positive and negative effects upon their inhabitants. In addition, edge preferences of predators have been supported in some ecosystems and not in others. Factors that make edge effect studies difficult for creating any generalizations are a lack of knowledge in several aspects and the inconsistency of research results. Accordingly, there are gaps in knowledge of several groups of organisms including spiders, ants, butterflies, lizards, *etc.* and of several types of adjacent areas namely plantations adjacent to forests, *etc*, especially in tropical areas. These await further studies in order that certain principles and theories on edge effects can be formulated. Web-building spider assemblages are reasonably suitable for assessing their responses to edges. Although rubber plantation-forest edges are commonly found in many parts of Southern Thailand, studies on their effects are not known. In the present study, web-building spiders will be surveyed along transects across rubber plantation-forest edges. The prediction of the current research is that species richness of web-building spiders at the edge will be higher than the adjacent habitats. Since the edges are a transitional zone of neighboring habitats, spider species of both neighboring habitats will be found at the edges. This report will shed light on some principles that govern the responses of spiders to their physical environment. A better understanding of the effects of this edge type on web-building spider composition can help us to optimally manage forest habitats and biodiversity in Southern Thailand.

Extraction of mangrove forest parameters using Airborne LiDAR for a Tsunami run-up model

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In this thesis research, a Canopy Height Model (CHM) derived from LiDAR was employed to extract essential parameters of mangrove tree attributes at the individual tree scale. Investigation of the relationship of tree crown with tree height using a ground inventory led to the implemention of linear regression which was used to specify the circular window size and so estimate tree apex, tree height and crown width from CHM. Comparisons of estimated values and ground truth values were established. RMS error and relevant statistics were considered. Consequently, to fulfill a Tsunami simulation model for calculation of resistance force, the effective stem volume and projected area under water level were critical parameters. Trunk shape functions based on the Komiyama model were implemented to calculate stem volume and projected area of mangrove trees at each water depth. To validate the estimated volume, the results derived from the Komiyama model must be equal to the integration volume obtained from the trunk shape function. Besides, DBH from function R(x) must be equal to DBH from the field survey. The results revealed that the relationship of tree height with crown diameter from the field inventory is positively explained by linear regression with a high value of the correlation coefficient (R2 = 0.791). TreeVaW is capable of extracting mangrove forest parameters from the Canopy Height Model (CHM) derived from LiDAR with RMS errors of 0.155m, 0.29m, 0.599m, 0.781cm, according to tree location in X, location in Y, tree height and crown width, respectively. Consequently, investigation of the strong relationship between DBH, tree height and crown width from the field (R^2 = 0.91) leads to the construction of a DBH model that can be used to estimate DBH from tree height and crown width from LiDAR. To validate the model, the estimated DBH was compared with the observed DBH resulting in a positive R^2 of 0.819. To simulate a Tsunami run-up model, a trunk diameter function for simulating tree trunk shape and calculating the attributes of mangrove trees was developed and investigated based on the assumption of a cylinder model and $R(x) = ax^b$ model. Examination of results indicates that the trunk diameter function has potential to calculate trunk volume and projected area under water level. Following outcomes will be further used to calculate the resistance force against a Tsunami wave in the Tsunami run-up model.

A new method to classify a cloud forest boundary using temperature and relative humidity data

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Temperature and relative humidity data were collected along an elevational transect from KN-3 Klong Gun station to Mt. Nom Peak, Mt. Nan National Park. Data were collected using a HOBO Pro V2 every five minutes during 16-29 January 2009. Average temperature decreased but average relative humidity increased with increasing elevation. The ranges of temperature and relative humidity increased with increasing elevation. The averages and ranges of temperature and relative humidity showed a sharp change at the elevation of 1100 m a.s.l. When temperatures at five elevations were paired, the regression slopes from each pair were categorised into three groups: (1) tropical rain forest, (2) the cloud forest boundary, and (3) cloud forest. When Y-intercepts and slopes of temperature and relative humidity were plotted with elevation, the Y-intercepts and slopes of temperature and relative humidity were separated into two groups: (1) 500-900 m a.s.l and (2) 1100-1300 m a.s.l. This clearly showed that the cloud forest boundary was located at 1100 m a.s.l.

Cloud forest characteristics at Mt. Nom, Thailand

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This study investigated the vegetation and soil characteristics of tropical montane cloud forest in Southern Thailand. We collected soil samples along a Mt. Nom elevational transect at five sites and measured soil pH, % soil moisture and % organic content in the laboratory. We measured tree height, shrub width, leaf thickness, leaf area and % epiphyte cover on every *Lithocarpus bennettii* (Miq.) Rehd. tree found on the Mt. Nom cloud forest trail which started at 313 m a.s.l. and ended at 1274 m a.s.l. Our results showed that percent soil moisture and % soil organic content increased with increasing elevation. Soil pH ranged from 3.6 to 4.3 which indicated that soil at Mt. Nom was highly acidic soil. As elevation increased, leaf thickness increased but leaf area decreased. There was no association between tree height and elevation. As elevation increased, shrub width decreased but % epiphyte cover increased.

Calibration of the BIOME-BGC model through a data assimilation technique with SPOT-VEGETATION data

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BioGeochemical Cycles (BIOME-BGC), an eco-system model, was calibrated at Mae Moh teak plantation site in northern Thailand using SPOT VEGETATION (S10) remote sensing data. A Genetic Algorithm (GA) was coupled with BIOME-BGC (BIOME-BGC-GA) to find optimized parameters which fit the simulated LAI into the LAI from the satellite. The optimized parameters for BIOME-BGC-GA gave a satisfactory correlation between simulated LAI and SPOT-LAI, especially in the rainy season when dynamic LAI changes are seen. The results demonstrated that the BIOME-BGC-GA method has high capability for optimizing eco-physiological model parameters in relation to seasonal LAI and resulted in accurate daily and annual NPP predictions for teak ecosystems in tropical regions. In summary, this study showed that assimilation of simulated data and remote sensing data into a process model may provide important information for modeling net primary production at a large scale.

Species diversity of acetic acid bacteria at Khanom-Mu Ko Thale Tai National Park, Nakhon Si Thammarat province

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One hundred and eighty-three bacterial isolates were made from 179 natural samples, such as flowers, fruits, algae, sand, etc., in Khanom-Mu Ko Thale Tai National Park, Nakhon Si Thammarat province, collected in March, 2007 and May, 2008. All isolates were purified and preserved in the BIOTEC Culture Collection for further studies. Seventy-nine representative isolates from different samples were selected for 5' end determination of 16S rDNA sequences. From a phylogenetic tree based on the 5' ends of 16S rRNA gene sequences and constructed by the neighbor-joining method, nine isolates did not belong to the cluster of acetic acid bacteria, fifty-two isolates were included in the lineage of three genera of acetic acid bacteria, *Acetobacter* (1 species), *Asaia* (3 species) and *Gluconobacter* (4 species), and eighteen isolates (25.7%) are suggested to be 5 new species. Among the 18 isolates, 3 isolates of three new species belonged to a new genus. Three isolates of three new species candidates belonging to two new genera, AH11, AH13 and AI15, were selected for further characterization of the proposed new genera and new species. The name of *Swingsia* gen. nov. was proposed with *Swingsia thailandicus* sp. nov. and *Swingsia tanensis* sp. nov. being proposed as names for AH11 and AH13, respectively.

Gluconobacter kanchanaburiensis sp. nov., a brown pigment-producing acetic acid bacterium in the *Alphaproteobacteria* from Thailand

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Two isolates, AD92^T and AD93, were obtained from spoiled fruits of *Artocarpus heterophyllus* (jackfruit) collected at Thong Pha Phum, Kanchanaburi, Thailand, in November 2003. In a phylogenetic tree based on 16S rRNA gene sequences constructed by the neighbor-joining, maximum parsimony and maximum likelihood methods, the two isolates were included in the sublineage of *G. oxydans*, but formed a quite independent cluster. They also formed a similar independent cluster in a phylogenetic analyses based on 16S-23S rRNA gene ITS sequences. The two isolates can be also distinguished taxonomically from the type strains of the nine *Gluconobacter* species by 16S-23S rRNA gene ITS restriction analyses, combinations of the five restriction endonucleases, *Mbo*II, *Bsp*1286I, *Bst*NI, *Bsa*JI and *Bso*BI, production of a water-soluble brown pigment, 2,5-diketo-D-gluconate from D-glucose, growth on pentitols and maltose, and requirement of nicotinic acid for growth. Therefore, the isolates AD92^T and AD93 are distinguished genetically, phylogenetically, phenotypically, and chemotaxonomically from the type strains of the nine *Gluconobacter* species and should be proposed as the tenth species of the genus *Gluconobacter*. The name of *Gluconobacter kanchanaburiensis* sp. nov. is proposed for the two isolates, AD92^T and AD93, in the higher DNA G+C content group, the sublineage of *G. oxydans*, or Phenon B.

Species diversity of yeasts at Khanom-Mu Ko Thale Tai National Park

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The diversity of yeast at Khanom-Mu Ko Thale Tai, Nakhon Si Thammarat Province, was investigated. One hundred and fifty yeast strains were isolated from sea water (58), plant materials in sea water and mangrove forest (57), seaweeds (18), soils and sands in mangrove forest (13) and miscellaneous substrates (4). A membrane filtration technique, and direct streaking and enrichment technique were used for isolation. Among the isolates, 111 strains were ascomycetous yeasts and 39 strains were basidiomycetous yeasts. Based on the D1/D2 domain sequence of the 26S rDNA gene, 129 strains were identified as 51 known species in 21 genera. The remaining 21 strains differed by 4 nucleotide substitutions or more from any known species; they are considered to represent 17 new species in 8 genera. It is concluded that yeasts are diverse in Khanom-Mu Ko Thale Tai National Park. Two strains of black yeasts, ST-1082 and ST-1158, are under study for morphological and physiological characteristics and chemotaxonomy in order to propose them as new yeast species from Khanom-Mu Ko Thale Tai National Park, Thailand.

Candida ranongensis sp. nov., an anamorphic ascomycetous yeast species isolated from water in a mangrove forest in Ranong province, Thailand

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Two yeast strains (RS17 and RS28^T) were isolated by membrane filtration from two estuarine water samples collected from a mangrove forest in Laem Son National Park, Ranong Province, Thailand. Analysis of the D1/D2 domain of the large subunit (LSU) rRNA gene sequence revealed that the sequences of the two strains were identical. The closest species in terms of pairwise sequence similarity was *Candida* sp. BG02-7-17-001A-1-1, an undescribed species, but the level of nucleotide substitutions (5.1%) was sufficient to justify the description of a separate species. Phylogenetic analysis demonstrated that the two strains clustered with *Candida* sp. BG02-7-17-001A-1-1 and was placed at a position distant from *Candida tritomae* and other related species. The two strains showed identical phenotypic characteristics, including proliferation by multilateral budding, absence of ascospores, arthrospores, and ballistoconidia and negative Diazonium blue B and urease reactions. The major ubiquinone was Q-9. On this basis, the two strains were assigned to a single novel species of the genus *Candida*, for which the name *Candida ranongensis* sp. nov. is proposed. The type strain is RS28^T (BCC 25964^T = NBRC 103861^T = CBS 10861^T).

Diversity of yeast in mangrove forest on the upper coast of the Gulf of Thailand: Comparison with Andaman Sea coastal mangrove forest

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The diversity of yeast in water and sediment from mangrove forests on the upper Gulf of Thailand on the east coast (Chantaburi and Trat) and west coast (Phetchaburi and Prachuap Khiri Khan) were investigated by identifying 112 isolated yeast strains on the basis of similarity analysis of the D1/D2 domain of LSU rDNA sequences. One hundred and six strains were found to be known species in the genera *Brettanomyces, Candida, Clavispora, Debaryomyces, Hanseniaspora, Kloeckera, Kluyveromyces, Kodamaea, Lindnera, Metschnikowia, Pichia, Rhodotorula, Saccharomyces, Torulaspora* and *Wickerhamomyces*, and two strains were similar to undescribed species namely *Pichia* sp. IS1-01 and *Aureobasidium* sp. CECT11965. Four strains were found to represent novel species which were named *Candida prachuapensis* sp. nov., *Candida siamensis* sp. nov., *Candida suwanaritii* sp. nov. and *Candida tratensis* sp. nov. The results of investigation revealed that *Candida thaimueangensis, Candida tropicalis, Kluyveromyces siamensis, Kodamaea ohmeri, Metschnikowia koreensis, Pichia kudriavzevii* and *Rhodotorula mucilaginosa* were detected in both east and west coastal mangrove forests of the Gulf of Thailand, whereas 17 yeast species, namely *Candida glabrata, Candida parapsilosis, Candida rugosa, Candida sanitii, Candida silvae, Candida thaimueangensis, Candida tropicalis, Kloeckera lindneri, Kodamaea ohmeri, Kluyveromyces siamensis, Lindnera subsufficiences, Pichia caribbica, Pichia guilliermondii, Pichia kluyveri, Pichia occidentalis Torulaspora maleeae* and *Rhodotorula mucilaginosa*, could be found in water of both the Andaman sea and the Gulf of Thailand coastal mangrove forests. The species which were frequently isolated from the Gulf of Thailand coastal mangrove forest in this study were *C. tropicalis, K. siamensis* and *R. mucilaginosa*.

Diversity of yeasts in soil from national parks in the north eastern part of Thailand and their role in degradation of organic matter in soil

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The diversity of yeasts in forest soils from 9 national parks, 2 wildlife sanctuaries, 3 forest parks and 8 other forests in the north-eastern part of Thailand was studied by isolation using an enrichment technique and identification based on the analysis of sequences of the D1/D2 domain of the large subunit rRNA gene and phylogenetic analysis. A total of 102 yeast strains were obtained from 60 soil samples. Eighty-one strains were identified to be 32 ascomycetous yeast species, namely *Candida akabanensis*, *C. diversa*, *C. ghanaensis*, *C. glabrata*, *C. nivariensis*, *C. orthopsilosis*, *C. pararugosa*, *C. pseudolambica*, *C. rugosa*, *C. saopaulonensis*, *C. tropicalis*, *Debaryomyces hansenii* var. *fabryi*, *D. nepalensis*, *D. vanrijiae* var. *vanrijiae*, *Geotrichum fragrans*, *G. vulgare*, *Kazachstania aquatic*, *K. bovina*, *K. siamensis*, *K. unispora*, *Kluyveromyces hubeiensis*, *Kodamaea ohmeri*, *Pichia caribbica*, *P. galeiformis*, *P. kluyveri*, *P. kudriavzevii*, *P. occidentalis*, *P. pijperi*, *Tetrapisispora namnaoensis*, *Torulaspora globosa*, *Williopsis saturnus* var. *mrakii*, *W. saturnus* var. *sargentensis* and *Zygosaccharomyces fermentati*. One strain was a basidiomycetous yeast, *Tricosporon mycotoxinivorans*. Twelve strains were found to be six undescribed species, similar to *Candida* sp. ST-533, *Pichia* sp. ST84, *Geotrichum* sp. CICC1364, *Geotrichum* sp. MTCC 3974, *Pichia* sp. RV60 and *Torulaspora* sp. WB17, and six strains could be known or new species. Moreover, based on polyphasic taxonomy, two strains were assigned to two novel species, which were named *Candida mokdahanensis* sp. nov. and *Geotrichum phurueaensis* sp. nov., respectively.

Biodiversity of biosurfactant-producing bacteria in mangrove sediment

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Biosurfactants are surface active compounds produced by a variety of microorganisms. They have a unique class of compounds that have been shown to have a variety of potential applications in the remediation of organic - or - metal contaminated sites, in the enhanced transport of bacteria, in enhanced oil recovery, as cosmetic additives, and in biological control. However, little is known about the distribution of biosurfactant-producing bacteria in the environment, particularly mangrove sediment. The aim of this study was to determine how common culturable surfactant-producing bacteria are in mangrove sediment. A total of 1033 used lubricating oil (ULO)-utilizing bacteria were isolated from 89 samples of mangrove sediment in the South of Thailand by an enrichment culture technique. The 1033 colonies were screened for biosurfactant production in mineral salts medium containing 1% ULO. Seventy seven and 69 isolates were found to be positive for biosurfactant production by a drop - collapsing test when ULO and glucose were used as carbon sources, respectively. Twenty isolates were tested for biosurfactant production in different carbon sources (glucose, commercial sugar, glycerol, used lubricating oil and used vegetable oil) by using surface tension reduction capability. Strain 318 displayed the highest reduction of surface tension (from 55.5 to 38.7 mN/m) for 24 h of incubation time when molasses was used as a carbon source.

A study of systematic position of *Phaeoisaria clematidis*

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Phaeoisaria clematidis is a common anamorph species of fungi in freshwater. It can be found worldwide on submerged wood and recently an isolate has been reported as an opportunistic pathogen in human. It is therefore potentially significant to human health. In Thailand, the teleomorph of *P. clematidis* differs from teleomorphs of other *Phaeoisaria* species. This teleomorph-anamorph connection was further confirmed by culture studies. Until now the teleomorph of Phaeoisaria had not been reported and its relationship to other fungal genera is unknown. The aim of this investigation is to evaluate the phylogenetic position of this teleomorph-anamorph link based on both molecular and morphological data.

Diversity study of invertebrate-pathogenic fungi in Mo Sing To Plot, Khao Yai National Park

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The research project "Diversity Study of Invertebrate-Pathogenic Fungi in Mo Sing To Plot, Khao Yai National Park" has been carried out to survey the ecology and diversity of invertebrate-pathogenic fungi in three permanent plots. The main objectives of this project are (1) to identify the presence of insect-fungi in Mo Sing To, (2) to know the hosts of insect-fungi in the plot, (3) to identify the factors affecting host populations and (4) to identify the factors affecting fungal populations. The three permanent plots are twenty by twenty meters in area which were set on different elevations. Plots A, B and C are 726.52, 783.10 and 806.62 meters above sea level, respectively. From surveys of insect-fungi associated with the upper and underside of leaves, the maximum observation height of leaves was 2 meters. Preliminary results for the first 5 months obtained from permanent plots A, B and C were 384, 94 and 478 total data records of insect-fungi, respectively. They revealed a diversity of 22 samples which were mostly identified to the genus and species levels. However, to achieve these objectives and understand the factors that affect growth and development of fungi, surveying and data recording is planned every month for the first two years.

Fungal communities on decaying sago palm, *Metroxylon sagu*, in Trang province

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Fungal communities on decaying sago palm, *Metroxylon sagu*, were examined in one collection at Trang province. Sixty-three species of saprobic fungi were isolated and identified including 24 ascomycetes and 39 anamorphic fungi. Three were identified as species new to science. The fungal communities on different frond parts, i.e., leaves, rachides, and petioles, were compared. Thirty-six species were found on rachides, and 22 and 5 species were found on petioles and leaves, respectively. The greatest differences of fungal communities were found between the leaves and rachides. Leaves of sago palm were dominated by species of *Lophodermium*, *Phoma* and *Pseudospiropes*. *Linocarpon*, *Massarina* and *Oxydothis* dominated petioles and rachides. This study has confirmed that fungi on palms are highly diverse and the data has important implications towards future biodiversity studies and estimates of Thai fungal and global fungal numbers.

Inhibition of the oil palm pathogen, *Ganoderma boninense*, by endophytic fungi from the palm, *Licuala spinosa*

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The biodiversity of endophytic fungi from the fan palm, *Licuala spinosa*, in Kuan Kang Hot Spring, Kantang, Trang province, was investigated, yielding 195 and 182 morpho types (in two studies), with 75 and 68 xylariaceous morpho types, and 3 and 10 coelomycetes, respectively. Four hundred and twenty strains were selected and grown on Yeast Extract Agar (YEA) to measure their radial growth rate at 10 days. They were grouped as: fast growth (5.91-7.20 cm), moderate growth (2.50-2.90 cm) and slow growth (0.01-2.49 cm). Three hundred strains were selected to determine their antagonistic ability against the oil palm pathogen, *Ganoderma boninense*, by a dual culture test. A 5 mm diameter disc from the growing edge of *G. boninense* was placed on one side of a YEA medium in a Petri dish and a 5 mm diameter disc from the growing edge of the endophytic fungal isolate placed on the other side of the dish. The plates were incubated at 25°C and the diameter of the fungal colonies recorded daily for 15 days to determine antagonistic activity. For the control, a disc from the growing edge of *G. boninense* was placed alone at one side of a Petri dish and growth measurements taken. Each test was replicated three times. Eighty-six isolates exhibited high antagonistic activity (> 60% inhibition of the growth of *G. boninense*) while 17 isolates showed a high antagonistic activity (> 80% inhibition). These seventeen isolates will be further evaluated for their ability to produce bioactive compounds.

Phylogenetic analysis of four species of *Falcocladium* using rDNA sequences of three loci

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Falcocladium species are new anamorphic taxa isolated and described from *Eucalyptus* and leaf litter collected from Brazil and Thailand. This genus is characterized by "having thick-walled, non septate stipe extensions that terminate in a vesicle and falcate appendaged conidia". *Falcocladium* species have been exclusively investigated based on morphological observations, and their taxonomic position is unresolved. Cultural studies have failed to link the genus to a known teleomorph. Therefore, four *Falcocladium* species, (*F. multivesiculatum, F. sphaeropedunculatum, F. thailandicum* and *F. turbinatum*) were examined at the molecular level using three loci, comprising SSU, LSU and ITS regions of ribosomal DNA. Phylogenetic analysis of the combined datasets of SSU and LSU regions demonstrates that four species of *Falcocladium* form a monophyletic group and group within the Hypocreomycetidae (Sordariomycetes). This genus forms a distinct lineage which is closely related to a clade comprising the genera, *Etheiophora, Jucigena, Swampomyces* and *Torpedospora* (TMB clade of Schoch *et al*., 2007). In order to determine the ordinal and familial levels to which *Falcocladium* species belong, further genes will be sequenced such as RPB2 and EF1. Currently this genus cannot be linked to a known teleomorph.

Phylogenetic relationships of three selected marine ascomycetes *(Carinispora nypae, Helicascus nypae* and *Tirisporella beccariana*) from *Nypa fruticans* in Thailand inferred from nuclear ribosomal DNA and protein sequences

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Decaying fronds and stems of the brackish water palm *Nypa fruticans* were collected from intertidal regions in Tambon Bang Pao, Amphor Kantang, Trang Province, Thailand. Single spore isolations were made, and cultures deposited in the BIOTEC Culture Collection (BCC). Dried specimens were deposited in the BIOTEC Bangkok Herbarium (BBH). Six species were commonly found: *Aniptodera nypae*, *Astrosphaeriella striatispora*, *Carinispora nypae*, *Linocarpon appendiculatum*, *Tirisporella beccariana* and *Trichocladium nypae*. Phylogenetic relationships of three selected marine ascomycetes *(Carinispora nypae, Helicascus nypae* and *Tirisporella beccariana*) from *N. fruticans* were investigated using combined ribosomal DNA (SSU and LSU) and protein (EF1 and RPB2) sequences. 505 sequences from these regions from 165 species were aligned. A combined data set was analysed phylogenetically using Maximum Parsimony and Bayesian Inference. Both analyses showed that *Carinispora nypae* clustered with *Caryospora rhizophorae* and *Quintaria lignatilis* to form a sister clade to the Subclass Pleosporomycetidae, Order Pleosporales, family Testudinaceae, but with no statistical support. Bayesian Inference showed that *Tirisporella beccariana* grouped within the Subclass Dothideomycetidae, Order Botryosphaeriales, family Botryosphaeriaceae, whereas *T. beccariana* clustered with *C. rhizophorae*. *Helicascus nypae* clustered with *H. kanaloanus* and formed a clade with marine *Massarina* species (*Massarina rammunculicola*, *M. thalassiae*, *M. velataspora*) in both analyses. In conclusion, the phylogenetic relationships of *C. nypae* and *H. nypae* can be resolved from this study. For *T. beccaniana,* further samples are required to resolve the taxonomic position of this unique marine monotypic genus.

Endophytic fungi associated with seagrass (*Enhalus acoroides*, Hydrocharitacea) at Had Khanom Mu Ko Thale Tai National Park, southern Thailand

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Seagrasses are flowering plants inhabiting coastal and marine environments, with a worldwide distribution in temperate and tropical regions. They serve as feeding, breeding and nursery grounds for important marine organisms. Little information is available on fungi associated with seagrasses, especially fungal endophytes. Therefore, the tropical eelgrass *Enhalus acoroides* was collected from Had Khanom-Mu Ko Thale Tai National Park. The objectives of this project were to investigate the presence of endophytes in *E. acoroides* and test for their antimicrobial activity. This study yielded 42 fungal assemblages, isolated from four collections over one year. Our results confirm that *E. acoroides* harbored fungal endophytes. This is the first report of endophytes associated with seagrasses from Thailand. Molecular identification of endophytes based on LSU and ITS1, 2, 5.8S rRNA sequences revealed a diversity of fungal groups including two Phyla: Ascomycota (98%) and Basidiomycota (2%). Three major Ascomycota classes, including the Eurotiomycetes, Sordariomycetes and Dothideomycetes, were determined. Eight genera and two species were fully identified while others remain to be characterized. The predominant 12 isolates (29%) were members of the Hypocreales, followed by the Eurotiales and the Capnodiales, respectively. Fermentation broths, from selected fungal endophytes, were tested for their antimicrobial activity by agar well diffusion. Approximately 16% displayed antimicrobial activity against at least one pathogen with significant inhibition zones. Therefore, our study has revealed that marine endophytes are potentially useful as good sources of natural antimicrobial compounds.

A new lineage of the genera *Ascotaiwania, Canalisporium* and *Savoryella* inferred by multiple genes and a new lignicolous taxon, *Ascothailandia grenadoidia* gen. *et* sp. nov., reported from Thailand

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The taxonomic placement of freshwater and marine *Savoryella* species has been widely debated and species have been assigned to various orders. This study incorporates individual phylogenetic datasets and a combined dataset, based on the small subunit rDNA (SSU), large subunit rDNA (LSU) and RNA polymerase II, the second largest subunit (RPB2) and ITS region, to determine the ordinal positions of the genera *Ascotaiwania* (A), *Canalisporium* (C) and *Savoryella* (S), all based on strains isolated from Thai substrata and including their type species. The ordinal statuses of (A) and (S) are unknown and these genera are consequently classified as Ascomycota *incertae sedis*. *The anamorphic genera, Monotosporella, Helicoon* (anamorphs of *A. sawadae, A. mitriformis* and *A. hughesii*), and *Canalisporium* have also been studied. Phylogenetic analyses indicate that the genera (S), (A), and (C) share a common ancestor and are closely related. In the SSU, LSU, RPB2 and ITS dataset, *Savoryella* shows no affinities with the Hypocreales, Halosphaeriales, Sordariales and Xylariales despite earlier assignment to the orders Sordariales and Hyprocreles. Our findings suggest a new lineage (ACS clade = *Ascotaiwania, Canalisporium, Savoryella*) of aquatic ascomycetes that have invaded both marine and freshwater habitats. *We also describe Ascothailandia* gen. nov. from submerged wood at Hala Bala Wildlife Sanctuary, Thailand. This genus is morphologically similar to the genera (A) and (S), but it differs in the acomata, asci, apical ring and spores (shape, dimension and colour) from these genera. Our phylogenetic results show that this taxon is well placed in the Hypocreomycetidae and bears close phylogenetic affinities to *Canalisporium* species.

Taxonomy, phylogenetics and diversity of *Dothideomycetes* in Thailand

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The *Dothideomycetes* in Thailand are poorly studied. In fact, the sooty moulds (*Capnodiales*) have hardly been researched. In this project we are studying the sooty moulds on mostly living leaves as well as other *Dothideomycetes* on decaying leaves and wood in northern Thailand. At the same time we have loaned types of *Dothideomycetes* genera from herbaria and are redescribing these fungi. This is important as the *Dothideomycetes* are generally poorly known and are not well documented. We have made numerous forays and have more than 20 collections of *Dothideomycetes* species. We are in the process of identifying these collections and have isolated many. The isolation of these fungi is not easy as often more than one taxa is mixed with others. We have identified several genera, i.e., *Astrosphaeriella* sp., *Guignadia* sp., *Botryosphaeria* sp. and *Phragmocapnias* sp., and are starting to carry out molecular work on the isolates.

Biodiversity of Xylariaceous fungi associated with termite nests in Thailand

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Xylaria species associated with termite nests are poorly known. Only 25 species of *Xylaria* have been described worldwide. Termite-associated *Xylaria* were collected in this study and more than 10 morphologically different species were recognized and described: *Xylaria acuminatilongissima, X. atrodivaricata, X. brunneovinosa, X. cirrata, X. escharoidea, X. intraflava, X. kedahae, X. nigripes, X. ochraceostroma, X. piperiformis* and *X. reinkingii*. In addition, more than 5 species are waiting for identification and description. LSU, ITS rDNA and protein coding gene (α-actin and β-tubulin) sequences have been amplified and sequenced from fifty-two strains. Phylogenetic trees of protein coding gene sequences separate them into 2 major groups, the Hypoxyloideae and Xylarioideae groups (i.e., the plant-associated group and the termite nest-associated group, respectively). The termite-associated strains were identified as *Xylaria escharoidea*, *Xylaria brunneovinosa*, *Xylaria nigripes* and *Xylaria* sp.II, which appeared to be in clades A, B, C and D, respectively. There were many unidentified *Xylaria* species from termite nests that formed independent groups and these should be named. The use of protein coding genes to separate the termite- and plant-associated *Xylaria* is better than the use of the ITS and LSU genes.

The diversity of ticks and harbored microorganisms in central, east, and northeast Thailand

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Ticks are associated with humans and animals. They are ectoparasites of many animals such as reptiles, amphibians, and mammals. In addition, ticks play key roles as hosts of microorganisms with symbiotic relationships. There are various kinds of microorganisms that can live in ticks, for example, bacteria, protozoa, viruses, and fungi. Some of them are pathological microorganisms that can cause diseases in humans and animals. So, in this research pathological microorganisms in ticks and tick species in Thailand are being investigated. In particular, we aim to show some relationships between ticks and their harbored microorganisms, including their co-evolutionary relatedness. To detect microorganism DNA, we use a polymerase chain reaction technique (PCR) and to identify microorganisms, we use a DNA sequencing technique. Study areas will be selected according to the provinces located in Central, East and Northeast Thailand. Moreover, ticks in National Parks in these regions will also be studied.

Factors influencing production and diversity of ectomycorrhizal fungi (EMF) in Pha Taem National Park, Thailand

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The research project entitled "Factors influencing production and diversity of Ectomycorrhizal Fungi (EMF)" is being carried out in Dry Dipterocarp Forest of different stand characteristics in Pha Theam National Park, Thailand, between 2008 and 2010. There are four objectives as follows:

1. To study the production of mushrooms which are classified as Ectomycorrhizal fungi (EMF) in Dry Dipterocarp forest
2. To identify, classify and analyze the diversity of EMF in Dry Dipterocarp forest
3. To analyze the association of forest stand characteristics and species richness and the production of EMF
4. To analyze the relationships of soil and climatic factors with species richness and production of EMF

In the first year, there were two permanent plots (40 meters x 40 meters) established in Dry Dipterocarp Forest with *Shorea siamensis* and *Dipterocarpus obtusifolius* being dominant. The positions and production of EMF occurring in these two plots were measured. Then, they will be analyzed in association with microclimatic conditions. The study will be continued in the coming year. It is expected that the findings and analysis from this research will be beneficial for improving the local economy through increasing production and capacity for mushroom manipulation. This in turn will result in the maintenance of biodiversity and in sustainable management.

Plant-parasite interactions in a tropical forest: wild cinnamon (*Cinnamomum subavenium* Miq.) and its specific parasitic fungus (*Traphina sp.*)

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The wild cinnamon tree, *Cinnamomum subavenium* Miq. (family Lauraceae), was studied together with its specific parasitic fungus (*Traphina* sp.) by investigating its habitat association and spatial distribution. This tree species is very common in the study area of the MoSingto forest dynamics plot, Khao Yai NP. Saplings are especially abundant and are becoming an important dominant species. However, the population dramatically declines approximately 1,000% from the stage of 1–5 cm dbh (diameter at breast height) to the next larger one, 5–10 cm dbh. The fungus is host specific and may have some role in controlling the plant population. The population was grouped into 3 stages: seedling, dbh < 1 cm; sapling, dbh 1–10 cm; and tree, dbh >10 cm. The results indicated that stages of *C. subavenium* were unaffected by elevation above sea level, the percent cover by *Strobilathus* sp., an understory dense-crowned bush, and forest gap. However, all stages of *C. subavenium* were associated with slope and perpendicular distance from the nearest stream. The spatial patterns of all stages were aggregated in all nearby areas of the plot. The fungus was studied only at the seedling and sapling stage since it was rarely found at the tree stage. Among parasitized plants, only the seedling stage showed a trend, i.e., a negative correlation with the percent cover. For the sapling stage, there were no trends for any characteristics. We suggest that the fungus probably kills some individuals of wild cinnamon at the sapling stage masking any seen trends at the seedling stage.

Lichen diversity and monitoring of sulphur dioxide around Mae Moh power plant area, Mae Moh district, Lampang province, in 2008

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Lichen diversity and sulphur dioxide concentration around Mae Moh power plant area, Mae Moh district, Lampang province, was studied. A plot size of 1x1 km^2 was selected in each of ten study sites in the area around Mae Moh power plant and lichen diversity and sulphur dioxide were monitored. A grid frame size of 20 x 50 cm^2 was used for registration of lichen species and their frequencies on 10 mango trees (*Mangifera* spp.) in each plot. Tree bark was sampled for pH analysis. Amospheric sulphur dioxide concentrations were sampled in each study site twice in the rainy and dry seasons by using a passive sampling technique. A total number of 22 lichen genera were found over all study sites. Crustose lichen species were more abundant than foliose lichen species at every study site. The highest lichen diversity was found in Sop Pad village, while the lowest lichen diversity was found in Sop Jang village which also had the lowest species richness. The highest species richness was found in Kor Ruak village. The highest sulphur dioxide concentration of 8.65 ppbv was found in Mae Jang village, which is the nearest site to the power plant whereas the lowest sulphur dioxide concentration of 0.84 ppbv was found in Sop Pad village, in a direction south of the power plant, which was located upwind from the power plant during the sampling time. However, there was no correlation between lichen diversity and sulphur dioxide concentration around Mae Moh power plant area in this study.

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

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Algal soil conditioner products (composed of 4 selected polysaccharide-producing strains, i.e., *Nostoc* sp. TISTR 8290 and 8873 and *Nostoc muscorum* TISTR 8871 and 9054) were tested on vegetable crops (Pak Choy and/or cabbage) at Lum Takhong Research Station. Three experiments were conducted separately. The results of each experiment revealed the following: 1) The granulation product (GP) (Ø 3-6 mm) containing each strain or mix of the 4 strains at 10^5 CFU/g could improve soil properties and crop productivity but did not show significant differences ($p \leq 0.05$); 2) The GP of size 3-6 mm (at 10^5 CFU/g) and 0.5-2 mm (at 10^8 CFU/g) showed better crop productivities than liquid products (at 10^5 and 10^8 CFU/ml), and small GP gave better results than large GP; 3) The application of small GP at 500 kg/rai with chemical fertilizer (13-13-21) at 50 kg/rai and small GP at 1,000 kg/rai with chemical fertilizer (13-13-21) at 100 kg/rai resulted in the best improvement in both crop productivity and soil properties for Pak Choy and cabbage, respectively.

Diversity of benthic diatoms in the main rivers of Thailand and establishment of a water quality index

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A study on the diversity of benthic diatoms and water quality in the main rivers of Thailand was carried out in March 2008 (the dry season). It was found that the dominant species of benthic diatoms in the Ping River were *Gomphonema parvulum* (Kützing) Grunow, *Luticola mutica* (Kützing) D.G. Mann and *Nitzschia palea* (Kützing) W. Smith. *Gomphonema* sp. 1, *Luticola* sp. 1 and *Nitzschia palea* (Kützing) W. Smith were dominant species in the Tha Chin River, *Encyonema mesianum* (Cholnoky) D.G. Mann, *Eunotia* sp. 1 and *Navicula radiosa* Kützing in the Chantaburi River, *Synedra ulna* (Nitzsch) Ehrenberg, *Cocconeis placentula* Ehrenberg and *Sellaphora pupula* (Kützing) Mereschkowsky in the Kwai River, *Rhopalodia gibba* (Ehrenberg) O. Müller, *Nitzschia clausii* Hantzsch and *Navicula symmetrica* Patrick in the Chi River and *Gomphonema clevei* Fricke, *Cymbella turgidula* Grunow and *Gomphonema* sp 2 were found to be dominant species of the Tapee River. Some physical and chemical factors were investigated for evaluating general water quality. The results found that water quality based on trophic status and water quality of most sampling sites were not clearly different, and could be classified as being of clean-moderate water quality (oligotrophic-mesotrophic status). However, the water quality of some sampling sites was different, especially of site 1 in the Tapee River, which was classified as having clean water quality (oligotrophic status) and sites 4 and 5 in the Tha Chin River which were classified as having polluted water quality (eutrophic status).

Epiphytic diatoms on blades of the seagrasses, *Cymodocea rotundata* and *Thalassia hemprichii*, at Ban Pa Khlok, Phuket province

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Epiphytic diatoms were collected from seagrass blades of *Cymodocea rotundata* and *Thalassia hemprichii* at Ban Pa Khlok, Phuket province, in October 2006 and March 2007. A total of 61 species, 32 genera and 18 families of epiphytic diatoms were found. The species diversity of epiphytic diatoms on seagrass blades, *C. rotundata* and *T. hemprichii*, were 59 and 57 species, respectively. The very common species which comprised more than 70% of the total number were 18 species in 10 genera such as *Cyclotella stylorum*, *Actinoptychus senarius*, *Mastogloia* sp.1, *M. rhombica*, *Lyrella lyra*, *Amphora ovalis*, *Amphora* sp.1, *Diploneis crabro*, *D. ovalis*, *Diploneis* sp.1, *Navicula* sp.1, *Pleurosigma* sp.1, *Pleurosigma* sp.2, *Nitzschi* sp.1, *Nitzschia* sp.2, *Nitzschia* sp.3, *Nitzschia* sp.4 and *Surirella fastuosa*.

Effect of ecological factors on species diversity of copepods in Suphanburi, Kanchanaburi, Ratchaburi and Phetchaburi provinces

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A study on the diversity of freshwater copepods in Suphanburi, Kanchanaburi, Ratchaburi and Phetchaburi Provinces was conducted. Samples were qualitatively collected from 200 habitats (218 samples) during February 2007 to March 2009. Fifteen species belonging to 7 genera of calanoid copepods were found. Species frequently encountered were *Mongolodiaptomus botulifer* (Kiefer) and *Phyllodiaptomus praedictus* Dumont and Reddy (57.8% and 28.9% of the sampled localities). Canonical Correspondence Analysis (CCA) indicated that phosphate, nitrate and conductivity were the most important environmental variables influencing the distributions of some calanoid copepods. *P. christineae* Dumont, Reddy and Sanoamuang and *M. dumonti* Sanoamuang, 2001 tended to be found in habitats where nitrate was higher than 2.87 µs/l while *Eodiaptomus draconisignivomi* Brehm, *E. phuphanensis* Sanoamuang, *Heliodiaptomus elegans* Kiefer, *H. viduus* (Gurney), *M. malaindosinensis* (Lai and Fernando) and *Neodiaptomus blachei* Brehm tended to be found in habitats where nitrate was lower than 2.87 µs/l. *P. thailandicus* Sanoamuang and Teeramaethee, *M. botulifer, Dentodiaptomus javanus* (Grochmalicki) tended to be found in habitats where conductivity was higher than 0.33 µs/cm and phosphate higher than 0.34 µs/l, while *N. schmackeri* (Poppe and Richard) and *M. calcarus* (Shen and Tai) tended to be found in habitats where conductivity was lower than 0.33 µs/cm and phosphate lower than 0.34 µs/l.

Species diversity of calanoid copepods in Thai waters of the Andaman sea

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The species diversity of calanoid copepods in Thai waters of the Andaman Sea was investigated during November 2005 to May 2007. Samples from 142 stations were collected by using horizontal, vertical and oblique towed nets of 330 µm mesh size. A total of 80 species in 28 genera were found. Fifty-nine species in twenty-five genera in this study were first records in Thai waters of the Andaman Sea and 19 species in 9 genera, namely *Centropages calaninus* (Dana), *C. elongatus* Giesbrecht, *Euchaeta rimana* Bradford, *E. wolfendeni* A. Scott, *Haloptilus spiniceps* (Giesbrecht), *Labidocera pectinata* Thompson & Scott, *L. bengalensis* Krishnaswamy, *Pontella danae* Giesbrecht, *P. diagonalis* Wilson, *P. fera* Dana, *P. investigatoris* Sewell, *P. spinipes* Giesbrecht, *P. valida* Dana, *Pontellina morii* Fleminger & Hulsemann, *Pontellopsis armata* (Giesbrecht), *P. krameri* (Giesbrecht), *P. scotti* Sewell, *Rhincalanus cornutus* Dana and *Scolecithrix danae* (Lubbock), were first records for Thai waters (Gulf of Thailand and the Andaman Sea). Furthermore, another six unidentified species in the genera *Labidocera* (3 species), *Pontella* (2 species) and *Pontellopsis* (1 species) are potentially new records for this area.

Feeding ecology of dominant calanoid copepods in Pak Phanang estuary, Nakhon Si Thammarat province

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Gut fluorescence of the dominant calanoid copepods, *Pseudodiaptomus annandalei*, *Pseudodiaptomus* sp. and *Acartia sinjiensis*, in Pak Phanang estuary, Nakhon Si Thammarat province, were investigated. The gut fluorescence analysis showed the highest gut chl *a* of 2.55 μg ind^{-1} and gut phaeopigment of 2.50 μg ind^{-1} in female *P. annandalei* collected from ta western mangrove plantation in the wet season (October 2007), while male *P. annandalei* from Pak Nakhon estuary contained 0.35 μg ind^{-1} of gut chl *a* and 0.707 μg ind^{-1}gut phaeopigment. In the dry season (May 2008), gut chl *a* and gut phaeopigment of *P. annandalei* was 0.342 μg ind^{-1} and 1.439 μg ind^{-1} respectively, in female and 0.172 μg ind^{-1} and 0.792 μg ind^{-1} male copepods from Pak Nakhon estuary. Gut fluorescence of *A. sinjiensis* was lower than 0.20 μg ind^{-1} in both sexes. *Pseudodiaptomus* sp. which dominated the western mangrove plantation had gut chl *a* of 0.534 μg ind^{-1} and gut phaeopigment of 0.156 μg ind^{-1}. Gut fluorescence of *P. annandalei* and *Pseudodiaptomus* sp. tended to decrease with chlorophyll *a* from microplankton while those of *A. sinjiensis* increased with chlorophyll *a* from nanoplankton and picoplankton fractions.

Potential and efficiency of using freshwater bryozoans for water quality improvement

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Because of limited migration, easy collection and living in a wide range of environments, freshwater bryozoans have potential for use as bio-indicators of water quality. This study aims to investigate the relations of growth of freshwater bryozoans with water quality in a natural reservoir and under simulated conditions. After 8 weeks in ponds, the species attached and growing on test materials were identified. The results showed that the freshwater bryozoans, *Hislopia malayensis*, *Plumatella casmian*a and *Plumatella chulabhornae*, grew well on plastic net. The growth rate was slow in the initial stage and rapid growth occurred during the 4^{th} and 5^{th} weeks. The densities of freshwater bryozoans covering plastic nets were classified as high, medium and low, and zooids were counted. *H. malayensis* had more zooids than *P. casmiana* and *P. chulabhornae* for all densities. Freshwater bryozoans can grow well in natural reservoirs where parameters of water quality change within a small range. However, under controlled conditions of nutrients, nitrate and phosphate addition, *H. malayensis* showed more endurance than *P. casmiana* and *P. chulabhornae*. The nutrient concentration had effects on their survival; the starting point for death was similar but the extermination point was different.

Species composition and habitat use and the influence of predators on habitat selection of *Acetes* spp.

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The species of the genus *Acetes* are mainly fished and are of significant commercial importance at Taladyai Bay, Had Khanom Mu Ko Thale Tai National Park, Nakhon Si Thammarat. They are small planktonic shrimp living in fresh water rivers, brackish water, the open ocean, mangroves and seagrass beds. Changes in water temperature, rainfall, tide, local winds, food supply and the presence of predators may be important for fishing seasons. This present study aims to gather information about the species composition, habitat uses, and habitat preference of *Acetes* shrimps. As well, the influence of predatory fish on habitat selection by *Acetes* shrimps will be investigated. The outcome of this study will provide ecological data for management of the *Acetes* shrimp fishery.

Diversity, distribution and variation within species of the genus *Halimeda* Lamouroux (Chlorophyta, Caulerpales) in Thailand

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This study investigated the diversity, distribution and variation within species of the genus *Halimeda* Lamouroux in Thailand. *Halimeda* were collected from various sites both in the Gulf of Thailand and the Andaman Sea. The specimens were preserved and deposited in the Princess Maha Chakri Sirindhorn Natural History Museum. Fourteen morphological characters and twenty-eight anatomical characters were examined using the morphometric method of Verbruggen (2005). There were 9 species found, namely *Halimeda macroloba* Decaisne, *H. discoidea* Decaisne, *H. opuntia* (Linnaeus) J.V. Lamouroux, *H. melanesica* Valet, *H. tuna* (J. Ellis & Solander) J.V. Lamouroux, *H. simulans* M.A. Howe, *H. gigas* W.R. Taylor; and 2 unidentified species. There were 4 new records for Thailand: *H. tuna* (J. Ellis & Solander) J.V. Lamouroux, *H. simulans* M.A. Howe, *H. gigas* W.R. Taylor and *H. melanesica* Valet. There were 2 species found in the Gulf of Thailand and 9 species found in the Andaman Sea. *Halimeda macroloba* Decaisne is the most dominant species; and there were significantly variances in the diameter of peripheral utricles in surface view, length and width of segments, node height, pore size, size of peripheral utricles and number of utricle layers of *H. macroloba* between sites ($p < 0.05$).

Effects of light, sediment and salinity on growth, pigments, agar production and reproduction in Gracilaria fisheri (B.M. Xia & I.A. Abbott) I.A. Abbott, J. Zhang & B.M. Xia at Koh Yor, Songkhla Lagoon, Songkhla Province, Thailand

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Gracilaria fisheri (B.M. Xia & I.A. Abbott) I.A. Abbott, J. Zhang & B.M. Xia is a red alga, distributed in the tropics. In Thailand, *G. fisheri* is known to be abundant in Songkhla Lagoon and Pattani Bay. Especially in Songkhla Lagoon, the population of *Gracilaria* spp. has declined because of development around the lake. The aim of this research is to study the effects of salinity and sediment on growth, pigment content, the amount of agar and reproduction of *G. fisheri*. The experiments were set up to test the effects of salinity and sediment on *G. fisheri* under different conditions based on a preliminary survey of Songkhla Lagoon between 2006 – 2007, in short-term (5 day) and long-term (30 day) responses. The algae were cultivated at a temperature of 25 ^{o}C, 3 levels of salinity (33, 25, 0 ppt), 4 levels of light intensity (1000, 700, 400 and 150 µmol photons m^{-2} s^{-1}) and 3 levels of sediment (2.28, 0.67, 0 mg). Photosynthesis was measured during the first 5-day experiment; photosynthesis biomass, pigments and agar were measured after the 20-day experiment. The results showed that all growth parameters were highest in 25 ppt of salinity, low light intensity (150 µmol photons m^{-2} s^{-1}) and no sedimentation whereas chlorophyll α and phycocyanin were influenced by high sedimentation. In addition, the photosynthesis rate was highest in 25 ppt, low light intensity and no sedimentation after cultivation for a long period. *G. fisheri* growth showed positive correlations with light intensity and salinity.

Seaweed and seagrass reference collection at the Princess Maha Chakri Sirindhorn, Natural History Museum, Prince of Songkla University, Hat Yai, Thailand

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A reference collection is known to be primarily important for systematic study in biology, where specimens are systematically deposited and, later on, can be used and referred to by others. It is also useful for ecologists who are interested in distribution and biogeography. Here we establish a systematic system to preserve and collect seaweed and seagrass specimens. The specimens will be collected in 4 forms: herbarium sheet, 4% seawater formaldehyde, 70% alcohol, and silica gel. Each specimen will be clearly labeled and recorded into an Excel sheet. The four types of specimens would help us to identify the specimens including the use of molecular techniques for silica gel-preserved speciemens if needed. There are almost 2,000 specimens which have come from the coastal shore of Thailand in our collection. An online system is now developed for wider access for those who are interested in tropical seaweeds and seagrasses. We are also looking for further collaboration by having a net-work of seaweed and seagrass researchers, who would like to deposit their specimens at the museum. This indeed would help to build up a complete database of seaweeds and seagrasses in Thailand; and the collection could become a central reference collection as well as be useful for postgraduate students and researchers.

A comparison of the diversity and abundance of sessile benthic organisms on reefs that have suffered different levels of damage at Ko Tan, Nakhon Si Thammarat province, Thailand

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The diversity and abundance of sessile benthic organisms were investigated on the shallow subtidal reefs of Koh Tan, Mu Koh Thale Tai, Nakhon Si Thammarat Province. Sampling sites were selected in 2 reef categories, 1) "the poor" and 2) "the good" categories, in each of the intertidal zone, reef flat and reef slope. Sampling was carried out in the rainy season between July to September 2008 and in the dry season between February to April 2009. Salinity, light, temperature, current, total suspended solids, NO_3^- and PO_4^{3-} were measured. There were 31 species of coral, 13 species of macroalgae, 6 species of sponge and 7 species of other benthic organisms in this research. The highest diversity occurred in February and the lowest diversity in July. The most abundant orgarnism is *Pavona* sp. on good reef of the reef flat. A one-way ANOSIM test for reef categories using a Bray-Curtis similarity matrix with non transformed species abundance data showed a significant effect at the 0.1% level (R=0). Thus there is a similar effect of benthic organisms on community structure within sites, but not between reef categories.

Organisms associated with the seagrass bed at Ko Tharai, Nakhon Si Thammarat Province

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Organisms associated with a seagrass bed at Ko Tharai, Nakhon Si Thammarat Province, were investigated. These included groups that live in sediment, on the bottom floor, in the water column, and on seagrass leaves. The results showed that polychaetes and amphipods were the dominant groups (55% and 44% respectively) in the sediments of the seagrass bed. On the bottom of the seagrass, 89.5% were shrimps while 10.5% were crabs. Three groups of shrimps were found: *Penaeus* (83.7%), *Metapenaeus* (11.8%) and Alpheidae (4.5%). In addition, most crabs were Portunidae (97.1%), which included *Portunus* (52.9%), *Thalamitta* (41.2%) and *Scylla* (2.9%). There were 56 species in 32 families of fish in the seagrass bed. The dominant species were *Siganus javus* (38%), followed by *Siganus canaliculatus* (24%) and *Leiognathus equulus* (13%), respectively. Commercial fish species, such as *Lutjanus russelli*, *Lethrinus lentjun* and *Epinephelus coioides*, were also found. Fish occurred in the seagrass bed mainly in the pre-juvenile and juvenile stages. The diversity index (H') in this study was 1.238 – 1.994.

Relationships between the population dynamics of the blue-swimming crab and seagrass beds in Khung Krabaen Bay, Chantaburi province

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Seagrass beds in coastal ecosystems play an important role as nursery grounds and habitat for marine animals, particularly the blue-swimming crab *(Portunus pelagicus)* which is an economic species in this country. Currently, the crab population is decreasing rapidly due to many factors particularly the degradation of seagrass beds. Khung Krabaen Bay was selected as a study site because two species of seagrasses, namely *Enhalus acoroides* and *Halodule pinifolia*, grow there. This bay historically has had a high blue-swimming crab fishery production and provides economic returns to the local fishermen. Therefore, this study aims to explore relationships for further setting up a sustainable management plan. Samples were collected monthly between April 2008 and March 2009. A total of 42 collapsible crab traps (mesh size equal to 1 and 2 cm) were used to collect crabs in both the daytime and the night-time in 4 patches of *E. acoroides*, 2 patches of *H. pinifolia*, and 1 area without seagrass cover as a control station. Crabs were sexed and weighed and carapace widths were measured. Thereafter, they were separated into 2 development stages as juvenile and mature. The sex ratio of males to females was 1:0.50. Carapace width ranged from 10-130 mm. The relationships between carapace width and weight were $W_{male} = 0.0001CW^{2.8264}$ and $W_{female} = 0.0002CW^{2.7859}$. Moreover, the juvenile crab had a correlation with *H. pinifolia* in the daytime at $P < 0.05$. In conclusion, this bay is facing a declining blue-swimming crab population.

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

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Enhalus acoroides (L.f.) Royle is one of the largest species of seagrass and is common in the Indo-Pacific tropics. In Haad Chao Mai National Park, Trang Province, *E. acoroides* grows in dense meadows, in which plants might undergo self-shading. The aim of this study is to investigate the effects of density on growth, recruitment and reproduction. Experiments were carried out from August 2006 to July 2007 in a monospecific meadow of *E. acoroides* by placing ten permanent quadrats (0.25 m^2) in each of 4 densities designated as follows: 100% density (35 shoots/quadrat), 50% density (18 shoots/quadrat), 25% density (9 shoots/quadrat) and 10% density (4 shoots/quadrat). The densities were manipulated by cutting the shoots at the leaf bundle meristem. Leaf elongation rate, leaf surface area, shoot weight, recruitment rate and numbers of flowers and fruits were recorded. In addition, the light intensity under canopies was measured. The results showed that under-canopy light intensity was significantly and negatively correlated to shoot density. Leaf surface area and aboveground dry weight were positively correlated to light intensity, while recruitment rate was negatively correlated to light intensity. However, there was no relationship between reproductive output (flower and fruit production) and light intensity. The results suggest that self-shading occurred and that light availability is an important factor in the regulation of growth in *E. acoroides* meadows.

Taxonomy of the subfamily Ptychanthoideae in the family Lejeuneaceae (Bryophyta, Hepaticae) in Thailand

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Five hundred and fifty specimens of leafy liverworts in the family Lejeuneaceae, subfamily Ptychanthoideae, were collected from seven National Parks, *i.e.*, Doi Suthep-Pui, Doi Inthanon, Pha Daeng, Phu Kradueng, Mu Koh Chang, Khao Nan and Khao Luang, and one wildlife sanctuary, *i.e.*, Phu Luang in Thailand. Ten genera and twenty-four species were found. *Lopholejeunea* (7 spp.) and *Mastigolejeunea* (5 spp.) are the most common genera. Also, there are two species which have not been recorded for Thailand, *viz*, *Lopholejeunea herzogiana* Verd. and *Lopholejeunea zollingeri* (Stephani) Schiffner.

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

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Thirty-nine species and 5 varieties of *Fissidens* Hedw. are known in Thailand. These include 2 new species (*F. bentanii* K. Wong. & Santa. and *F. kanyanii* K. Wong. & B.C. Tan) and 5 new records (*F. flaccidus* C. Muell., *F. incognitus* Gangulee, *F. involutus* Wils. *ex* Mitt., *F. jungermanniodes* Griff., and *F. serratus* C. Muell.). One thousand, nine hundred and three specimens were collected from 18 National Parks, *i.e*., Doi Inthanon, Doi Suthep-Pui, Pha Daeng, Phu Hin Rong Kla, Phu Phan, Pu kradong, Phu Kao-Phu Phan Kham, Tat Ton, Pa Taem, Pu-Toei, Khao Yai, Kaeng Krachan, Khao Cha Mao - Khao Wong, Khao Khitchakut, Nam Tok Phlio, Nam Tok Ngao, Khao Nan, and Phanom Pencha, and 2 Wildlife Sanctuaries, *i.e*. Pu Luang and Chiang Dao. This study revealed that new species and new records are continually being found and new taxonomic and ecological information on Thai *Fissidens* will continue to be accumulated. More collecting in other areas of Thailand is needed to determine if more species are present in the country.

Ecological studies on the epiphytic bryophyte vegetation along altitudinal gradients of Nakhon Si Thammarat Range, Thailand

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Ecological studies on the epiphytic bryophyte vegetation will be undertaken along altitudinal gradients in southern Thailand. The purpose of this study is to determine species richness, to classify epiphytic bryophyte communities using the Braun-Blanquet method, and to correlate them with ecological parameters such as altitude, temperature and air humidity. In addition, measurements of the pH of bark of the host trees will be taken, together with determinations of the water storing capacity and percentage cover of epiphytic bryophytes along altitudinal gradients. The transect will cover typical tropical rainforest types from the lowland to the summits of mountains. Within a transect, sampling plots will be placed at 200 m intervals. Voucher specimens will be deposited in the Prince of Songkla University Herbarium (PSU), Department of Biology, Faculty of Science, Prince of Songkla University, and the Forest Herbarium (BKF), National Parks, Wildlife and Plant Conservation Department.

Diversity of pteridophytes in cloud forest at Khao Nan, Nakhon Si Thammarat Province

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The diversity of pteridophytes at Khao Nan National Park was explored from July 2007 to May 2009 at elevations from above 60 m to the summit of selected mountains. In all, 671 specimens were collected, and 28 families, 86 genera, and 298 species were determined. Among these, 3 families, 5 genera and 24 species were fern allies, while 25 families, 81 genera and 274 species were ferns. Among these, one species, namely *Adiantum latifolium* Lam, is an escape from cultivation and has become naturalized. In addition, four potential new species from the 4 genera, *Adiantum*, *Asplenium*, *Lycopodiella* and *Pleocnemia*, were found and need more investigation by comparing them with type specimens deposited in overseas herbaria. It is expected that new data on pteridophyte diversity gained from this study will be useful for future management of the Khao Nan area.

Flora of Thailand

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Since its launch in 1963 the Flora of Thailand has covered barely 50% of the estimated 9,000 Thai species. To date, nine volumes (in 24 parts) have been published, with a total of 4410 taxa. As a signatory to the Convention on Biodiversity (CBD), in which many CBD initiatives are directly connected with taxonomic outputs, e.g., Global Taxonomy Initiative – GTI, Global Strategy for Plant Conservation – GSPC, Plant Red Data, etc, none are achievable without the taxonomic base-line data that the Flora of Thailand generates. In addition, areas with high endemism and threatened plants can only be identified and hence given top priority for protection with access to taxonomic base-line data. Funded by the Biodiversity Research and Training Program of Thailand (BRT), large problematic families such as Euphorbiaceae and Fagaceae have been studied and these families are now completed and printed (Flora of Thailand vol. 8/1, 8/2, 9/3) within the remarkably short period of less than 4 years. The speeding up of the Flora of Thailand Project initiated in 2008, again funded by BRT, has facilitated significant progress with the families Araceae (Boyce), Gesneriaceae (Middleton), Rubiaceae (Puff), Clusiaceae & Vitaceae (Parnell), Rutaceae (Esser), and Begoniaceae (Sands) with the hope that they will be accomplished not later than 2011. Most remaining untreated families for the Flora of Thailand have now been assigned to an author, and a time schedule drawn up and distributed. According to this time schedule over the next 3-5 years all families with more than 100 species will be completed with the result that 80% of the Flora will be covered. This will greatly facilitate further floristic research, assist with the training of the next generation of local botanists, and provide the data to enable CBD programmed work and initiatives.

An assessment of OS2AP gene distribution in natural wild rice populations (*Oryza rufipogon* Griff.) in Thailand, Laos and Cambodia using PCR-based DNA markers

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

Physiological responses, antioxidants, anthocyanin and expression of genes involved in anthocyanin biosynthesis in rice under salinity stress

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High salt or soil salinity is a major environmental stress in plant agriculture worldwide that adversely affects plant growth and metabolism. Adverse plant responses to salinity stress depend on the osmotic and toxic effects of salt and on the level and duration of the stress. This study was designed to determine physiological changes, antioxidants, anthocyanin content and mRNA expression involved in anthocyanin biosynthesis in rice varieties under salinity stress. Two classes of Thai rice lines including cyanic (Riceberry, Kum and Kumdoisaket) and acyanic (KDML 105, Sinleg, BC2F7#248-35 and BC2F7#62-56) were hydroponically grown. Seedlings were grown for 16 days and were supplied with saline nutrient solutions of 0 (control), 20, 40 and 60 mM NaCl for 11 days. The roots, leaves and leaf sheaths were collected, frozen in liquid nitrogen and stored at –70 ^{0}C. The relative growth inhibition, total chlorophyll content, Na^{+} and K^{+} concentration, antioxidant activity, total phenol content, lipid peroxidation, anthocyanin content and mRNA expression of the seedlings were examined. Results from this study are crucial for understanding molecular mechanisms of adaptation, which might be developed for plant breeding to improve rice nutritional value with high anthocyanins in planting areas of soil salinity.

Genetic diversity of *Shorea obtusa* Wall. ex Blume in Thailand based on microsatellite markers

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Shorea obtusa Wall. ex Blume is a keystone species of the dry deciduous dipterocarp forest in Thailand. The aim of this study was to better estimate how genetic structure can be used to obtain a conservation perspective of this species. In this study, genetic variation at the population level of this species was evaluated by means of five microsatellite markers. The mean expected and observed heterozygosity values were 0.664 and 0.438, respectively. Significant departures from Hardy-Weinberg equilibrium, when a heterozygosity deficit indicated a high level of inbreeding, were evident in all populations studied. Population differentiation (*Fst*) was low with 3 % of genetic variation partitioned among populations. Genetic distance analysis showed that two populations (Chang Rai and Chaiyaphum) are genetically distinct from the three other populations (Uthai Thani, Ubon Ratchatani and Maha Sarakham).

Genetic diversity of *Kaempferia* in Thailand using AFLP analyses

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Members of the genus *Kaempferia* (Zingiberaceae), such as *K. marginata* (Wann Tuup Muup or Proh Thuean), *K. galanga* (Proh Hom), *K. roscoeana* (Proh Paa), *K. rotunda* (Waan Dok Din), and particularly *K. parviflora* (Krachai Dum), are recognized as medicinal herbs, vegetables, or ornamentals. Approximately 20 *Kaempferia* species occur in Thailand and 9 species of closely related taxa were examined by Amplified Fragment Length Polymorphism (AFLP) analyss. Six primer combinations (E-AG/M-GA, E-AG/M-GG, E-TT/M-TT, E-GG/M-GT, E-ACT/M-CAA, and E-ACG/M-CTA) were tested against 80 accessions for developing AFLP fingerprints. A UPGMA dendrogram revealed that all *Kaempferia* accessions, except *K. candida*, were allocated to the same group. Disregarding *K. candida*, other *Kaempferia* species were divided into 2 major groups; one group showed a relatively higher level of genetic variation of AFLP fingerprints than the other. AFLP results also revealed that *K. galanga* may be a cultivated variant of *K. marginata*. Although this study confirmed that *Kaempferia* species, in which inflorescences appear before leafy shoots, clustered in the same group, the present AFLP data were unable to distinguish among these species (i.e. *K. rotunda*, *K. grandifolia*, *Kaempferia* sp. (Proh Mang Mum), and *Kaempferia* sp. (Proh Mueang Kan). In general, results inferred from AFLP analysis were concordant with those from cpDNA (*psbA-trnH* and *petA-psbJ*) data.

Genetic and morphological diversity and distribution of *Etlingera littoralis* (Zingiberaceae) in southern Thailand

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Etlingera littoralis or Pud Kang Kok is widely distributed in the Malay Peninsular, including Thailand. *E. littoralis* was first discovered and described from Phuket, Thailand. Unfortunately, the type specimen was lost at sea. Later studies have then been based only on the species morphological descriptions from its protologue. There is another morphologically similar species to *E. littoralis*, *E. megalocheilos* which is found in Borneo. These two similar species are sometimes treated as a single species by some botanists, synonymising *E. megalocheilos* under *E. littoralis*. Is *E. megalocheilos* also found in the Malay Peninsular? From our fieldwork, we have found that there are two forms of the inflorescences of *E. littoralis*, especially regarding labellum characteristics. The first form in populations has its entire labellum red and longer proportionally to other floral parts, while the other form has its labellum edge yellow and shorter. We are also working on its genetic diversity by using an Amplified Fragment Length Polymorphism (AFLP) technique. By combining morphological and genetic diversity data, along with the distribution patterns of *E. littoralis* in Southern Thailand, we hope that we can shed light on its identity and prove that *E. megalocheilos* is actually found also in the Malay Peninsular.

Field surveys of natural populations of *Begonia* in Thailand

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Field surveys of natural populations of the genus *Begonia* (Begoniaceae) in all parts of Thailand from June 2007 - May 2009 were conducted. So far, 55 recognized species have been collected from various habitats on various substrata, i.e., terrestrial, epiphyticand lithophytic. Natural populations of all *Begonia* occurred only near streams/waterfalls or on humid places such as moist bark/rocks from low elevation about sea level in the eastern part and the peninsula to the summits of mountains over 2,000 m in northern Thailand. All species found were either annual or perennial herbs, coming out in the rainy season. Concerning taxon abundance and distribution, collected *Begonia* could be roughly divided into three groups, i.e., northern taxa, central taxa and peninsular taxa. Only one species was found all over the country, i.e. *Begonia integrifolia* Dalzell, and another two taxa each occurred in two floristic regions (south-eastern and peninsular), i.e., *Begonia sinuata* Wall. ex Meisn. var. *sinuata* and *B. variabilis* Ridl. Otherwise, each taxon is recorded from only a single floristic region of Thailand.

Molecular taxonomy of the tribe Vernonieae (Asteraceae) in Thailand

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Sequences of the nuclear ribosomal DNA ITS region and two chloroplast regions, the *ndhF* gene and the noncoding spacer *trnL-F*, from 50 accessions were used to assess relationships among 34 species of Vernonineae in Thailand. The sequence data were analyzed in combination using maximum parsimony, maximum likelihood, and Bayesian methods. The posterior probability value using the Bayesian method was always higher than that of other statistics; however, the topologies did not show conflict. All analyses indicated *Elephantopus* and *Camchaya* are monophyletic whereas *Vernonia s.l.* is polyphyletic. The molecular phylogeny in this study clearly supported the resurrection of the genera *Acilepis*, *Cyanthillium*, *Monosis* and *Strobocalyx*. However, the circumscription of *Decaneuropsis*, *Koyamasia*, *Tarlmounia* and *V. gymnoclada* needs further resolution. The phylogenetic hypotheses indicated that *Iodocephalus eberhardtii* and *I. gracilis* were paraphyletic with very strong support, which suggests the former should be described as a new genus whereas the latter should be included in the genus *Camchaya*. The molecular phylogenies of the tribe are also supported by pollen and morphological studies.

The genus *Mussaenda* L. (Rubiaceae) in Thailand

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Sixteen species of *Mussaenda* L. in Thailand have been reported in "Thai Plant Names", including ornamentals. By field collections and examination of herbarium specimens, together with consulting published documents, the authors found 24 species in this study. One of them, *M. intuspilosa* Jayaweera, is the first record for Thailand. Summarized results and a discussion of work could be affordable with some apparent considerations relating to the genus.

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

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A study on the diversity of vascular plants on the cliffs and rocky ridges of Sankalakhiri range in Betong district, Yala province, was conducted from October 2005 to February 2007. A total of 223 plant species were recorded. Seven species were lycophytes, 41 species were pterophytes, three species were gymnosperms, 115 species were dicots and 57 species were monocots. The family Orchidaceae was the largest group of plants in the study area with 40 species. Two species are expected to be new to science, i.e., *Hoya* sp. and *Dendrobium* sp., and 16 species are newly recorded for Thailand, i.e., *Syngramma minima* Holttum, *Anodendron axillare* Merr., *Willughbeia tenuiflora* Dyer ex Hook.f., *Hoya imperialis* Lindl., *Elaeocarpus pedunculatus* Wall. ex Mast., *Didymocarpus citrinus* Ridl., *D. cordatus* A. DC. var. *cordatus*, *Henckelia bombycina* (Ridl.) A. Weber, *Paraboea elegans* (Ridl.) B.L. Burtt, *Pachycentria glauca* Triana subsp. *maingayi* (C.B. Clarke) Clausing, *P. hanseniana* Clausing, *Coelogyne prasina* Ridl., *C. testacea* Lindl., *Dendrobium metrium* Kraenzl., *Epigeneium geminatum* (Blume) Summerh. and *Geostachys penangensis* Ridl. In addition, four alien species were recorded in the study area, i.e., *Ageratum conyzoides* L., *Chromolaena odorata* (L.) R.M. King & H. Rob., *Clidemia hirta* D. Don and *Lantana camara* L. Descriptions of 129 vascular plant species and the status of these taxa together with ecological data, localities and distribution ranges of each species are presented as well as photographs. The vegetation types in the study area are described and illustrated. The variation in floristic composition of the vegetation on these mountain ridges is also discussed.

Phytosociology of the terrestrial vegetation along the coasts of peninsular Thailand

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Vegetation study on the natural vegetation along the coasts of the peninsular Thailand has been conducted from October 2006 - May 2009. Thirteen sites along the coast were selected as representatives of each subtypes. The coastal vegetation can be divided into two groups: I. the sandbar vegetation due to the sedimentation from the sea current comprising three categories: 1) dune grassland 2) dune scrub and 3) dune woodland communities. II. the sandbar vegetation due to strong wind. Only one site on the northernmost of the peninsula is recognized, comprising two categories: 1) dune grassland and 2) dune scrub communities. The profiles of the actual and natural vegetation on the sandbars and dunes along the coast are proposed.

The study of plant diversity in Phu Fa Development Center at Bo Kluea district, Nan province

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The purposes of this research are to (1) survey and collect data on natural plant diversity in the area of the community around the Phu Fa Development Center, (2) analyze the value chain of the utilization of natural plant diversity as local knowledge including; edible plants, herbal treatments and others, (3) create an electronics database that classifies data by land use zone and place it online as a web site, and (4) develop learning sources for local students by using an e-book program and media for providing this knowledge for conservation awareness. Research sites include several land use zones in the community around the Phu Fa Development Center such as the community, agricultural zone, and community forest.

The research method consisted of a line plot system technique to study plant diversity. The plot numbers and sizes were thirty of 1x1 sq. m, thirty of 5x5 sq. m and thirty of 20x20 sq. m. To study local knowledge on the use of natural plant diversity an in-depth-interview technique will be conducted of senior leaders of the community.

Results of the study are expected to include information on natural plant diversity and its use in local knowledge as well as to developing a database on a website. Also, it is expected to create learning media as an e-book program and a book for local school students in the Phu Fa Development Center area to develop their awareness of natural resource and local knowledge conservation.

Population structure and reproductive success of the genus *Sirindhornia* (Orchidaceae): a comparative study between local endemics and widespread *Sirindhornia* (Orchidaceae) species

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The Southeast Asian orchid genus *Sirindhornia* comprises three terrestrial species: *S. monophylla* (Collett & Hemsl.) H. A. Pedersen & Suksathan, *S. mirabilis* H. A. Pedersen & Suksathan and *S. pulchella* H. A. Pedersen & Indhamusika. In Thailand, we compared demographic characteristics between the local endemics *S. mirabilis* and *S. pulchella* and the widespread *S. monophylla*. The three species had similar demographic characteristics, but different reproductive attributes. The local endemics were more reproductively restricted than the widespread *S. monophylla*. Thus, the latter exhibited higher relative fruit set, and had more equal individual contributions of progeny. However, recruitment appeared to be more efficient in *S. pulchella* than in the other two species.

Pollen and seed morphology of the genus *Sirindhornia* (Orchidaceae) in Thailand

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Morphological features of pollen and seeds of the orchid genus *Sirindhornia* were examined using scanning electron microscopy. Exine sculpturing of the pollen and seed shapes were similar to those of other orchids in the subtribe Orchidinae found in European countries. The study revealed that palynological and seed morphology were significant characteristics useful in classification and identification of orchids in the genus *Sirindhornia*.

Alkaloids from *Clausena excavata*

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Clausena excavata is known locally as "Sun-soak" belonging to Rutaceae. Several parts of this plant have been used for the treatment of cold, malaria, AIDS, dermatopathy, abdominal pain, snake-bite, and as a detoxification agent. A number of coumarins and alkaloids have been reported from several parts of this plant. Some of these compounds showed anti HIV-1, antibacterial, antiplasmodial, anticancer, antimycobacterial, and antifungal activities. As part of our continuing chemical studies on Thai medicinal plants, we now report herein the isolation and identification of compounds which were isolated from the stems of *C. excavata* collected from Satoon Province, southern part of Thailand led to isolation of two new carbazole alkaloids, clausenaexcavin A (**6**), and clausenaexcavin B (**10**), together with ten known compounds, mukonine (**1**), methylcarbazole-3-carboxylate (**2**), *O*-methylmukonal (**3**), 3-formylcarbazole (**4**), mukonidine (**5**), clauszoline-I (**7**), *O*-demethylmurrayanine (**8**), clausine-Z (**9**), dictamine (**11**), *N*-(*p-trans*-coumaroyl)tyramine (**12**). Their structures were elucidated by spectroscopic methods.

Comparative pharmacognostic studies and *In Vitro* antioxidant activities of *Murdannia gigantea*, *M. macrocarpa* and *M. simplex* (Family Commelinaceae)

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Murdannia gigantea, *M. macrocarpa* and *M. simplex* (Family Commelinaceae) are difficult to distinguish, especially from sterile parts. The aims of this comparative pharmacognostic study are to evaluate for diagnosis and value-added plant resources, the use of microscopic (inflorescence bract clearing and transverse sections), phytochemical methods (physico-chemical values and thin layer chromatography) and *in vitro* antioxidant activities in regard to the ability to scavenge diphenyl picryl hydrazyl (DPPH) radicals, the ferric reducing ability by ferric reducing-antioxidant power (FRAP), phenolic contents (Folin-Ciocalteu) and the inhibitory activity of lipid peroxidation by thiobarbituric acid reactive substances (TBARs) in rat brain homogenate.

Comparative pharmacognostic studies and antioxidant activities of *Murdannia discreta, M. edulis* and *M. japonica* (Family Commelinaceae)

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Comparative pharmacognostic studies of three *Murdannia* species (Family Commelinaceae), namely *M. discreta*, *M. edulis* and *M. japonica*, were conducted using diagnostic methods of microscopy (inflorescence bract clearing and transverse section), phytochemical screening methods (physico-chemical values and thin-layer chromatography) and *in vitro* antioxidant activities [2,2-diphenyl-1-picrilhydrazyl (DPPH)**,** ferric reducing antioxidant power (FRAP), folin-ciocalteu and thiobarbituric acid reactive substances (TBARS) methods].

Development of fragrant flower plants for the purposes of decoration and essential oils

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The "development of fragrant flower plants for the purposes of decoration and essential oils" (3rd year) project has been undertaken since October 2007. The purpose of the project in this year was to study and select 46 species of cultivated fragrant flower plants suitable for use in aromatherapy. A case study in gardens surrounding 4 different sites**,** i.e., petrol station toilets, Thai traditional massage huts, rooms with herbal steam treatment and fitness parks, was conducted to improve microclimatic conditions and hide bad smells from customers. Landscape design was found to be relevant to the factors of light intensity, humidity, plant spacing, plant shape, flowering season and period, and time and distance of fragrant emissions. There were test runs, evaluation and improvments of landscape designs to suit the Thai style of self sufficiency. The resulting knowledge was distributed to BRT focus groups and interested persons through exhibitions, yearly academic meetings, poster presentations, press releases, training courses and books about BRT Projects.

Species diversity of vascular plants on limestone in Southeastern Thailand

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A study of the species diversity of vascular plants on limestone at Khao Chakan, Khao Lueam, Khao Ta Ngok, Khao Wong, Khao Cha-ang Ngonngaen, Khao Cha-ang On and Khao Yai in southeastern Thailand was undertaken from May 2006 to October 2008. One thousand, one hundred and sixty-six species (1,171 taxa)**,** 659 genera and 151 families are enumerated. The most common families were Euphorbiaceae, Leguminosae and Orchidaceae, respectively. Among them, 96 species were restricted to limestone. Two hundred and twenty-one species are classified as threatened. At least seven species are expected to be new species.

Meliaceae of Thailand

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Meliaceae of Thailand have been revised under the auspices of the Biodiversity Research and Training Program (BRT) since October 2006. In conclusion, the Meliaceae of Thailand consist of 18 genera, i.e., *Aglaia* Lour., *Aphanamixis* Blume, *Azadirachta* A. Juss, *Chisocheton* Blume, *Chukrasia* A. Juss, *Cipadessa* Blume, *Dysoxylum* Blume, *Heynea* Roxb., *Lansium* Corr., *Melia* L., *Munronia* Wight, *Pseudoclausena* T. Clark, *Sandoricun* Cav., *Swietenia* Jacq., *Toona* (Endl.) M. Roemer, *Turraea* L., *Walsura* Roxb. and *Xylocarpus* König, with 83 species and 5 varieties in total. Many species were reduced and some are new records to Thailand, i.e., *Aglaia palembanica* Miq., *Aglaia rufinervis* (Blume) Bantv., *Aglaia rubiginosa* (Hiern) Pannell, *Aphanamixis sumatrana* (Miq.) Ridley, *Dysoxylum acutangulum* Miq., *Dysoxylum angustifolia* King, *Dysoxylum mollisiamum* Blume, *Dysoxylum rubocostatum* Pierre, *Pseudoclausena chrysogyne* (Miq.) Clark. *Azadirachta indica* var. *siamensis* Valeton is maintained as the original variety and a new combination of *Chukrasia tabularis* A. Juss. var. *velutina* (M. Roem.) C. Phengklai has been made. All descriptions, line drawings and pictures are in process.

Phenology of some *Ficus* species and species diversity of fig-eating animals in Khao Nan National Park, Nakhon Si Thammarat province

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This project is the continuing second phase of the main project, "Species Diversity of *Ficus* L. (Moraceae) in Khao Nan National Park, Nakhon Si Thammarat Province". The present project emphasizes the ecological role of figs. The three main objectives are to determine: 1) the flowering and fruiting times of seven fig species (98 stems), including tree species in the terrestrial group, e.g., *Ficus obpyramidata* King, *Ficus fistulosa* Reinw. ex Blume and *Ficus schwarzii* Koord and four species in the strangling fig group, e.g., *Ficus benjamina* L., *Ficus microcarpa* Blume, *Ficus caulocarpa* (Miq.) Miq. and *Ficus sundaica* Blume; 2) the number and species of frugivores; and 3) the nutritional values of fig fruit. The project will start with the accumulation of all relevant information from various available sources, then planning for collecting field data, surveying and actual data collecting; including taking some photographs of figs and their attendant frugivores. Laboratory analysis of fig nutritional values will be done. Also the relationship of fig phenology with some environmental factors will be investigated. From the results 20 species of animals were found eating fig fruit; almost all were birds with only one mammal, the Grey-bellied Squirrel. Three fig fruit species were eaten by humans. Fruits contained protein, carbohydrate, fat, mineral, fiber and calories. Regarding the flowering and fruiting times of some *Ficus* species, they tended to appear at all months. The study results will be of great benefit as baseline data for further research and for the local utilization of figs; they can also be used for protected area management and the effective conservation of biological resources.

Project to conserve and develop the utilization of *Gluta* plants

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A project to conserve and develop the utilization of *Gluta* plants (1st year) has been undertaken since October 1, 2007. The purpose of this project is to study the distribution and the technologies for propagation and maintenance as well as to gather local wisdom for conservation and utilization of *Gluta* plants. The Genus *Gluta* in Thailand has 11 species. *Gluta ustitata* (Wall.) Ding Hou is the most utilized species in Thailand, Burma, Laos, Vietnam and also in Southern China because of its high latex content and its excellent quality for Lacquerware. The survey found *Gluta ustitata* in 21 provinces of Thailand with Chiang Mai having the greatest number of trees. The wild plants are exposed to wild fire and forest slashing-and-burning and the number of trees is gradually declining. Latex content is not enough for internal consumption and has led to illegal smuggling of low grade product from neighbouring countries. The value of lacquerware falls year by year. The study of local use showed that plantation enlargement, higher standards of lacquer trapping and higher standards for the lacquerware industry should be promoted for sustainable conservation of *Gluta ustitata*. Nowadays, there is a low number of naturally distributed trees. The percentages of seed germination and seedling viability in experimental plots are 91 and 27 %, respectively. Seedling damage was very high in the rainy season. Wilt-tolerant root stock would be very beneficial to *Gluta ustitata* cultivation.

Floristic composition and plant community structure of the Riparian forest along the Sok canal, Surat Thani province

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Riparian forests serve numerous important ecological functions and maintain an ecological equilibrium. However, riparian forest is a sensitive ecosystem that is prone to destruction by human activities. To conserve and restore riparian forests back to a healthy condition we need various aspects of research. One important basic information is the study of floristic composition and structure along environmental gradients of water courses to detect patterns of distribution, at both community and individual species levels, and to preliminarily survey the underlying factors controlling those patterns. Unfortunately, there is a lack of studies on almost all aspects needed. This study focuses on floristic composition and plant community structure of riparian forest along the Sok canal at Khao Sok National Park, Surat Thani province. Fifty 5x20 m plots will be established along the canal. All individuals with girths of more than 1cm at breast height (gbh = 1.3 m) will be sampled. The importance value index (IVI) will be calculated to analyze the floristic composition. Classification and ordination techniques will be used to characterize the structure of vegetation along the canal. The study can provide useful information on plant diversity and other community structure parameters as well as an understanding of the types of communities and possible factors that control their structures.

Management of access and benefit sharing of the use of biological resources by research organizations in Thailand

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After the Convention on Biological Diversity (CBD) introduced a new concept of using biological resources (BR), that is, of access and benefit sharing (ABS), Thailand has developed several ABS regulations which are administered by different government offices. According to these ABS regulations, users of domestic BR must inform or seek permission from the authority before utilizing those BR. In addition, a benefit sharing agreement is required if the products/results of such use is commercialized. This research studies the impact of ABS laws on researchers and research organizations in Thailand. The study finds that most researchers are unaware of the existence of ABS laws. They hardly comply with the regulations. As a result, it is difficult to conclude the impacts of the law on researchers and research organizations. However, some researchers opine that the law may have affected their research procedures, i.e., make them more complicated and less transparent. This study recommends that research organizations should set up a clear policy and guidelines on utilization of biological resources to encourage the legal use of biological resources at national and international levels. In addition, research organizations should set up a unit that deals with the utilization of biological resources. This study also develops ABS guidelines.

Species diversity of marine sponges dwelling in coral reefs of Had Khanom – Mu Ko Thale Tai National Park, Nakhon Si Thammarat province, Thailand

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The species diversity of demosponges dwelling in the coral reefs of Had Khanom–Mu Ko Thale Tai National Park, located in the southern Gulf of Thailand was investigated with field surveys undertaken at 14 sites in November 2006 and May 2007 using SCUBA and random observation. 47 species of demosponges from 10 orders, 24 families and 34 genera were recorded. The Order Haplosclerida had the highest species abundance with 15 species, followed by Poecilosclerida with 9 species and Dictyoceratida with 6 species The massive sponge was the most dominant growth form of the study area. 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.

Interspecific competition by scleractinian corals at Koh Tan, Surat Thani province, Thailand

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Coral reefs are one of the most dynamic and diverse marine communities with many of species highly specialized to a particular niche. At present, coral reefs are subject to many destructive forces of both natural and human induced agents that can severely damage coral communities. The physical environment plays an important role in determining the composition of coral communities, while the biological environment creates the wealth of species that is characteristic of coral reefs. Coral's aggressive capacities play a central role in the determination of its coverage and distribution. Information on which coral species can tolerate different kinds of competitive interaction and which coral species can succeed in certain conditions is required for future coral propagation and coral rehabilitation. This research will provide the first quantitative evidence of patterns and outcomes of competitive ability among corals in Thailand. The objectives of this study are: to investigate patterns of interspecific interaction and indicate competitive ability by quantification among different species of corals, and to identify interspecific interactions of corals under different conditions for coral reefs at Koh Tan, Surat Thani Province. The proposed study sites are the coral reefs at Koh Tan which is an island south of Koh Samui in the Gulf of Thailand. There is an urgent need to study the ecology of coral reefs at Koh Tan and the research outcomes from this study can be applied for future reef restoration or rehabilitation.

Application of a numerical water circulation model and dispersal of coral eggs and planula larvae around Had Khanom - Mu Ko Thale Tai

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In this study, a 2-D circulation model was applied to simulate tidal currents at Had Khanom – Mu Ko Thale Tai during 2008, and the dispersal of coral eggs and larvae during February - April 2008 was assessed based on velocity fields. Numerical model results showed that tidal currents in Had Khanom – Mu Ko Thale Tai were relatively weak, being less than 0.4 m/s. Strong tidal currents occurred only in the deep channels between islands. Eddies and current meandering occurred at the tips of the islands and these helped in mixing of the water mass, nutrient mixing and dispersal of coral eggs and planula larvae. The current simulation for February to April indicated that if coral spawned their eggs during the spring tide, there was a good chance that planula larvae would settle down at the brooding colony or nearby site with a high survival rate. But if the spawning occurred during the neap tide, there was a good chance that the planula larvae would settle down at a farther distance from their brooding colony. Finally, the relation between the spawning time and flood-ebb cycle revealed that if spawning occurred during the ebb cycle, there was a good chance that the current would carry the eggs and larvae out to sea, thus reducing the survival rate. But if the spawning occurred during the flood cycle, the current would carry the eggs and larvae to the islands north of the study site and the larvae could settle down around the islands there or come back to the spawning area by the ebb current.

A preliminary study of coral recruitment processes on reefs of Mu Ko Thale Tai

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In this preliminary study, we compared the early recruits onto settlement panels during the spawning peak of year 2007 with *in situ* juvenile abundance on reef substrates. The population of newly settled recruits was predominantly *Pocillopora damicornis* (60%) with lesser proportion of the genera *Porites* (16%), *Fungia* (10%), *Acropora* (4%), mixed faviid genera (4%), *Montipora* (1%) and unidentified group (5%). On the other hand, the majority of *in situ* juveniles were *Montipora* (24%), *Pocillopora* (18%), *Tubastrea* (13%), *Fungia* (11%) and *Favia* (10%). We found that coral recruitment varied spatially among the five islands of Mu Ko Thale Tai. While settlement rate was generally higher on Ko Mudsum and Ko Rab, settlement rate seem to be consistently lower on Ko Wang Nai. Moreover, average *in situ* juvenile abundance on reefs at Ko Taen and Ko Mudsum were higher than at the other reefs. Despite high rates of settlement at Ko Rarb, juvenile abundance there was low, implying that post-settlement mortality plays an important role in shaping the community structure. In addition, density of recruits on settlement panels translates to ~270 spat per square meter of bare substrate which is many times the density of juveniles found on natural substrate. Because bare substrate is quickly fouled by algae and sediment, further study is needed to differentiate the roles of substrate limitation and post-settlement mortality as controls on natural coral recruitment processes on these islands.

Organisms associated with gorgonians at Mu Ko Thale Tai, Surat Thani and Nakhon Si Thammarat

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The organisms associated with 3 different colony forms of gorgonians were investigated. Three gorgonian genera, *Subergorgia*, *Dichotella* and *Verrucella*, were chosen as representatives of 3 different forms, i.e., sparse, bushy and planar, respectively. Samples of each genus were collected from 3 different depths of water, shallow (< 5 m), mid-depth (5–10 m) and deep (> 10 m) in each study site of Mu Ko Thale Tai, Surat Thani and Nakhon Si Thammarat. The study sites included Ko Tan, Ko Mat Sum, Ko Rap, Ko Wang Nok and Ko Wang Nai. A total of 4,992 individuals in 8 phyla were found from 32 gorgonian samples. The 8 phyla were Porifera, Cnidaria, Platyhelminthes, Annelida, Sipunculida, Mollusca, Arthropoda and Echinodermata. The brittle stars (Ophiuroidea) and amphipods (Amphipoda) comprised the largest numbers of organisms associated with gorgonians. Moreover, there was a correlation between the numbers of organisms and forms of gorgonians. The highest number of associated organisms was found for *Subergorgia* with 4,579, followed by *Dichotella*, 341, and *Verrucella,* 72, respectively. From these results, the morphology of gorgonians is likely to influence habitat selection by associated organisms.

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

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Gorgonians are invertebrates in the Subclass Octocoralli, Order Gorgonacea. Gorgonians can be found in every ocean from tropical to temperate zones. In Thailand, only a few studies have been done on gorgonians. The purpose of this study was to investigate the diversity of gorgonians at Had Khanom – Mu Ko Thale Tai Marine National Park. The study areas included Ko Wang Nai, Ko Wang Nok, Ko Rab, Ko Tan, and Ko Mat Sum. A total of 15 genera in 7 families were found in the areas. The families and genera were: the Family Anthothelidae, *Solenocaulon*; the Family Subergorgiidae, *Subergorgia*; the Family Melithaeidae, *Melithaea*; the Family Acanthogorgiidae, *Anthogorgia*; the Family Plexauridae, *Euplexaura*, *Echinomuricea*, *Echinogorgia*, *Menella*, and *Astrogorgia*; the Family Gorgoiidae, *Rumphella* and *Pseudopterogorgia*; and the Family Ellisellidae, *Ctenocella*, *Junceella*, *Dichotella*, and *Verrucella*. Ko Rab had the highest gorgonian diversity (15 genera), followed by Ko Tan (13 genera). Ko Wang Nai had the lowest diversity (6 genera). *Subergorgia*, *Astrogorgia*, *Ctenocella*, *Junceella* and *Dichotella* were found on every island. In contrast, *Solenocaulon* occurred only at Ko Rab. From this study, *Astrogorgia* and *Verrucella* were first records of these genera in the Gulf of Thailand and in Thai waters, respectively.

Species diversity of nudibranches at Had Khanom – Mu Ko Thale Tai National Park, Nakhon Si Thammarat province Thailand

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Nudibranches belong to the mollusk group but have no shell protecting their soft bodies. In Thailand, approximately 60 species of nudibranchs have been found in the Gulf of Thailand and the Andaman Sea. However, no study has been done on the distribution and biology of nudibranches in Thailand. The purposes of this study were to investigate species diversity of nudibranchs at Had Khanom - Mu Ko Thale Tai Marine National Park and to gather baseline data for conservation and management of natural resources. There were five islands in the study: Ko Wang Nai, Ko Wang Nok, Ko Rab, Ko Tan, and Ko Mat Sum. A total of 19 species in 15 genera and 9 families were found at depths between 1-15 m. The difficulty and the ease in finding these nudibranchs were 42.1%. Phyllidiidae and Chromodorididae were the dominant groups. The dominant species was *Jorunna funebris*. From this study, *Chromodoris sinensis*, *Glossodoris cincta*, *Dendrodoris denisoni*, *Platydoris dierythros* and *Bornella stellifer* were first records of these species in Thai waters.

Species diversity of terrestrial earthworms in Lower Northern Thailand

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In this report we summarize current knowledge on earthworm diversity in Lower Northern Thailand. Up to now, 27 species belonging to 7 genera in 5 families are known from investigated territory. The analysis based on the keys of Gates (1972) and Sims and Easton (1972) shows that 23 species are native species and 4 species are introduced species (*Eisenia foetida, Eudrilus eugeniae, Polypheretima elongate* and *Pontoscolex corethrurus*). *Amynthas alexandri, Metaphire peguana, M. posthruma* and *Dichogaster affinis* are all found in provinces of Lower Northern Thailand. Our knowledge of the distribution and diversity of earthworm species is imperfect. This means that diversity and threat status must be viewed as working hypotheses based on the best available information. Any increase in knowledge for particular taxa could result in a change of threat category. Species are continually moved among categories, depending on particular factors that affect their numbers and distribution. This study should serve as a guideline and stimulus for further work on its improvement and revision, including the total number of earthworms and the threat category of each species.

Effects of the earthworm, *Polypheretima elongate,* on physical and chemical properties of saline soil in an abandoned shrimp farm of the Ranot soil series

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The physical and chemical properties of soils in abandoned shrimp farms after a period of inactivity in the upper, central, and lower parts of Songkla lake basin have been changed; soil properties have been downgraded. Deterioration in soil properties resulted from salt dispersion and compaction by machinery while shrimp ponds were being prepared. Consequently, critical properties of abandoned shrimp farm soils obstruct root passage under the ground. Freshwater is rare in the study area and runs short in the dry season. Restoration with earthworms is one way to restore and enhance soil properties by natural processes. They ought to promote soil physical properties which allow roots to grow easily resulting in the development of plant communities. The tropical earthworm, *Polypheretima elongate*, was collected from salt affected areas beside abandoned shrimp farms which were located in Tabon, Ranot district, Songkla province. The specimens were identified by means of Gates (1972). Mature stages of cultured earthworms were provided for amending physical and chemical properties of abandoned shrimp farm soil, which had bulk density 1.58 g/cm^3, ECe 1.65 ds/m, CEC 17.99 cmol/kg, ESP 44.97% and pH 7.76. The soil had been leached by freshwater for 3 months before earthworms were used. The study focuses on three factors including earthworm density (10, 20 and 30 individuals / 5 kg soil), types of organic matter (dried rice straw and decomposed litter) and quantity of organic matter (5%, 10 % by soil weight). The study needs experimental periods of at least 90 days and will examine chemical and physical properties of soils, including earthworm biomass, in initial and later experiments.

The construction of a Thai Trichoptera database based on biodiversity, biomonitoring and lotic ecosystem conservation perspectives

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For almost 25 years the Trichopteran fauna has been well studied throughout Thailand. To date, approximately 997 species have been reported (more than 78% representing new discoveries during this time period), mostly from the mountainous area of northern Thailand. The construction of a Thai Trichoptera database will provide knowledge on the entire spectrum of the fauna. It will be an important tool for evaluating the diversity and distribution trends of Trichoptera. Besides taxonomic reasons, biological and ecological research has indicated that Trichoptera species serve as major functional and structural components of lotic ecosystems (headwaters, streams and rivers) based on their great abundance and diversity. Comparisons of community composition among habitats or biotopes and altitudinal change from headwaters to lower reaches will be studied, as well as spatial and temporal changes. The data will allow discrimination of habitat attributes which will be useful for conservation purposes for maintaining the function and diversity of the ecosystem. Moreover, the conservation value (rarity index) of each species of caddisfly will be calculated. It provides a useful approach for gaining an understanding of the conservation status of the ecosystem and can be applied in decision-making for freshwater resource management. Recently, lotic ecosystems have been seriously threatened in all regions of the world by overexploitation, water pollution, flow modification, physical degradation of habitats, and invasion of invasive species. Assessment and monitoring of water quality and habitat complexity have been ongoing for some time, but further research is needed.

Survey of the diversity of mosquitoes susceptible to filarial parasites in the endemic area of *Wuchereria bancrofti* on the Thai-Myanmar border at Thong Pha Phum district, Kanchanaburi province, Thailand

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This research aimed to survey the diversity of mosquitoes which are vectors of filarial parasites of both humans and animals in rubber forest plantation areas at the sub unit of Ban Mea Num Noi, Huay Kayeng sub district, Thong Pha Phum district, Kanchanaburi province. Between November 2007 and October 2008, 32 species of various mosquitoes were found. Among the total number of 11,129 wild caught mosquitoes, 65 mosquitoes of 9 species (0.73%) were positive for filarial parasites. The filarial infective larvae that were morphologically identified as *Wuchereria bancrofti* were dissected from 5 species of mosquitoes, *Aedes desmotes*, *Ae. imitator*, *Ae. annandalei*, *Armigeres subalbatus* and *Coquiletidia crassipes*. These filarial infective larvae will be further identified by a PCR technique to determine species.

Taxonomic study of the *Diachasmimorpha longicaudata* complex in Thailand

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Diachasmimorpha longicaudata (Ashmead) is a parasitoid that has an important role in controlling fruit flies, which are serious pests of commercial fruits in agricultural areas. There has been taxonomic confusion concerning species differentiation in the *D. longicaudata* complex. In Thailand, *D. longicaudata* suspected to be cryptic species were collected and grouped by locality and host specificity. They were temporarily designated as DLA, DLB, and DLBB populations. In this study, the morphology of the male and female abdominal glands was examined. Our findings demonstrated differences in the Hagen's glands of the males of DLA, DLB and DLBB. The venom apparatus also presented anatomical differences in the females of these three populations. The internal morphology was shown to be useful taxonomic markers within the *D. longicaudata* complex.

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

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The parasitoid *Diachasmimorpha longicaudata* is a beneficial wasp and is an important biological control agent of tephritid fruit flies. Although *D. longicaudata* has been well studied, several researchers have documented and suggested that *D. longicaudata* is probably a species complex. In this research, reproductive isolation was confirmed among *D. longicaudata* populations by cross-mating experiments. These experiments indicated that *D. longicaudata* in Thailand is a species complex comprising at least three distinct species which are designated as DLA, DLB and DLBB. These cryptic species can also be separated by the PCR-linked, single-strand, conformation, polymorphism (PCR-SSCP) technique. Based on nuclear DNA (ITS2 and 28s regions) and mitochondrial DNA (COI and 16s regions), three different SSCP banding patterns were detected and different PCR products were found which indicates that genetic divergence exists within the *D. longicaudata* complex (DLA, DLB and DLBB). Therefore, the SSCP technique is further being used for genetic investigations of *D. longicaudata* populations from several different localities in Thailand in order to understand their genetic structure and to elucidate their taxonomic status.

Polytene chromosome studies of black flies: The *Simulium nobile* group in Thailand

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Cytological, morphological and ecological studies of black flies in the *Simulium nobile* group, *i.e.*, *S. nobile* and *S. nodosum*, in Thailand were conducted in this study. Polytene chromosomes of 512 larvae were analyzed by a band-by-band comparison technique using an established polytene chromosome standard map of the subgenus *Simulium.* Differences in polytene chromosome banding patterns of *S. nobile* and *S. nodosum* were found on the short arm of chromosome II (IIS) and the long arm of chromosome III (IIIL): 1) a Nucleolar Organizing Region (NOR) is on the IIS of *S. nodosum* whereas it is on the IIIL of *S. nobile*; 2) a pseudochromocenter is present in *S. nodosum* but absent in *S. nobile*. However, both species share two fixed inversions in chromosomes II and III, which differ from the standard map. In addition, seven populations of *S. nobile* are monomorphic while nine populations of *S. nodosum* have two floating inversions, which are IIL-1 and IIIL-1. Morphological study reveals differences between the two species in five morphological characteristics; larval color, pupal cephalic sheath, gill filaments, antennae and female genitalia. Ecological data show the distribution of *S. nobile* in the southern area of Thailand to be at low altitudes of 55.5 m from sea level, while *S. nodosum* distribution is in the northern area with high altitude of 489.69 m from sea level. The overall results indicate evolutionary relationships between these two species of the *Simulium nobile* group.

Ecology and symbiont studies of larval black flies (Diptera: Simuliidae) in Thailand

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Larval black flies are model hosts for investigating the associations of symbiotic organisms because they are taxonomically well known, widely distributed, common in all streams and rivers, and hosts of many symbiotes. Symbionts of black flies are almost unknown in Thailand, especially the trichomycete fungi. Therefore, we screened the larvae of black flies collected from northern and southern Thailand to determine the taxa of symbionts and their prevalences. Five groups of symbionts were found in larval black flies: nematodes (Family Mermithidae), microsporidia (Phylum Zygomycota), chytrid fungi (Class Chytridiomycetes, *Coelomycidium simulii* Debaisieux) trichomycete fungi (Class Trichomycetes), and ichthyosporean protozoa. The prevalences of infection for nematodes, micropsoridia and chytrid fungi was low, ranging from 0.1 to 7.1% of all larvae. Trichomycete fungi generally colonize the digestive tracts of arthropods, including black flies. In this study, *Harpella melusinae* (Family Harpellaceae) was the only species of trichomycete fungi found in the midgut. Four species of trichomycetes, *Genistellospora homothallica*, *Pennella* sp., *Simuliomyces microsporus*, and *Smittium* sp. (Family Legeriomycetaceae), and one species of an ichthyosporean protozoan (*Paramoebidium* sp.) were found in the hindguts of host species. The prevalence of *H. melusinae* was high (50-100%) in 29 populations of 11 black fly species and this species was most common in the midgut. Three species of black flies, *Simulium asakoae*, *S. nakhonense* and *S. nodosum*, were infected with 4 or 5 species of trichomycete fungi, whereas other host species were infected with 1 or 2 species. These results indicate that three species of black flies should be ideal hosts for further studies of trichomycete-host symbioses. This trend might reflect distributions of hosts and trichomycete fungi in relation to environmental factors.

Species diversity, taxonomy and distribution of fireflies (Coleoptera: Lampyridae) in northern Thailand

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Fireflies belong to the family Lampyridae Latreille, 1817. The glowing abdomen during the courtship period is characteristic of this group of insects. They are usually found in damp habitats. This family is composed of five subfamilies, namely Cyphonocerinae, Lampyrinae, Ototetrinae, Photurinae and Pterotinae. There are so far more than 100 genera and over 2,000 species described worldwide. From data records, about 100 species of fireflies have been morphologically recognized in Thailand. Northern Thailand is rich in ecological niches, therefore a high, richness of fireflies in this area is expected. The aims of this study are to survey species diversity and distributions of fireflies in the northern region of Thailand. The samples will be collected randomly in different geographic areas in Northern Thailand. The final result of the survey will be: a species list of the fireflies found in northern Thailand; diagnostics for each species; species distributions; and dichotomous keys to genera and species for identification of fireflies in northern Thailand. This knowledge can contribute to further study of the biology, taxonomy and sustainable conservation of fireflies in Thailand, and will also be an important contribution to a better understanding of the fauna of Thailand.

Ecotoxicology of acid stress on haemolymph composition of odonate nymphs in Banpu coal mine reservoir, Li district, Lamphun province

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Odonate nymphs and data on water physico-chemical parameters have been collected from Ban Pu coal mine acidic reservoir. Haemolymph samples of odonate nymphs were taken to determine ion changes compared with samples from a natural neutral reservoir. Sampling is being carried out between November 2008 and October 2009 from 4 sites, with 3 sites being located in the coal mine reservoir and one being the reference site. In comparison with the standard of surface water quality, water qualities were moderate. On the other hand, BP1G, BP1P and BP2, had high conductivity and TDS, which originated from coal in the reservoir. Concomitant with high sulfate ion concentration, only BP2 was found to have acidic water. Twenty one adult species and 20 nymph genera of odonate were found with the highest number at a site being at BP2. *Orthetrum sabina* was chosen for haemolymph collection. Na^+, Cl^-, K^+, Ca^{2+}, SO_4^{2-} and Mg^{2+} in the haemolymph were found. The major ions for *O. sabina* at BP2 and JL were Cl^- and Na^+, respectively. The ion compositions in *O. sabina* haemolymph were not significantly related to the ion compositions of BP2 and JL water.

Preliminary report of insect pollinator diversity on physic nuts (*Jatropha curcus* L.) in Thailand

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A diversity study of insect pollinators on physic nut flowers in Thailand was based on a survey of species in Chon Buri, Rayong, Chiang Mai and Lamphun Provinces. This study is a part of "The Bees (Order Hymenoptera: Superfamily Apoidea) as Insect Pollinators of Physic Nuts (*Jatropha curcus* L.) in Thailand" project. More than 107 specimens of insect pollinators were collected by sweep net from 08.00-12.00h during April to May 2009. The results of this survey found 107 species, which were divided into 6 orders, namely Hymenoptera, Diptera, Coleoptera, Lepidoptera, Hemiptera and Blattodea, and 42 families, namely Apidae (10 spp.), Anthophoridae (2 spp.), Colletidae (2 spp.), Halictidae (6 spp.), Megachilidae (1 sp.), Formicidae (5 spp.), Vespidae (15 spp.), Sphecidae (4 spp.), Scoliidae (3 spp.), Calliphoridae (2 spp.), Syrphidae (8 spp.), Asilidae (1 sp.), Bombyliidae (1 sp.), Dolichopodidae (1 sp.), Drosophilidae (1 sp.), Muscidae (1 sp.), Sarcophagidae (1 sp.), Stratiomyidae (2 spp.), Tachinidae (1 sp.), Therevidae (3 spp.), Tipulidae (1 sp.), Chrysomelidae (1 sp.), Nitidulidae (1 sp.), Elateridae (1 sp.), Curculionidae (1 sp.), Scarabaeidae (1 sp.), Danaidae (2 spp.), Nymphalidae (3 spp.), Pieridae (3 spp.), Lycaenidae (2 spp.), Papilionidae (6 spp.), Arctiidae (1 sp.), Noctuidae (1 sp.), Sessiidae (1 sp.), Satyridae (1 sp.), Hesperiidae (2 spp.), Pentatomidae (1 sp.), Coreidae (2 spp.), Scutelleridae (3 spp.), Pyrrhocoridae (1 sp.), Reduviidae (1 sp.) and Blattellidae (1 sp.). These 107 species need nectar and pollen from physic nut flowers in the event of shortages of other food sources. Physic nuts is a good food source for insect pollinators.

Diversity of Olethreutine moths (Lepidoptera: Tortricidae) in Khao Nan National Park

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A diversity 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 369 specimens of Olethreutinae were collected with blacklight and mercury vapor light on 60 nights during November 2007-October 2008. The survey resulted in collection of 155 morphotypes divided into 8 tribes, namely Microcorsini, Endotheniini, Gatesclarkeanini, Bactrini, Olethreutini, Enarmoniini, Eucosmini, and Grapholitini. Of these, 37 species in 27 genera are identified and 3 species are new records for the park and Thailand. The survey also included 44 morphotypes that can be identified to 22 genera, but not to species level and 74 morphotypes are unidentified. Of these, 8 genera are recorded for the first time and 4 species in 3 genera are new records for Thailand. The sex ratio between male and female is 2:1. The species accumulation curve increased gradually in each month. The species diversity index is 4.63 and evenness index is 0.91. For occurrence percentage of species, almost all are in the rare group.

Diversity study of butterflies in Khao Nan National Park, Nakhon Si Thammarat province

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A diversity study of butterflies was conducted at Khao Nan National Park, Nakhon Si Thammarat province, with the prime purpose being to determine existing species diversity, species abundance and conservation status. To gather field information, surveys were employed using a 1 km line-transect. The study was done every alternate month for 1 year, starting from 2007 through to 2008.

It was found from the present study that there occurred in the area about 352 species of butterflies, classified in 5 families and 172 genera, of which there were 130 Nymphalidae, 92 Lycaenidae, 68 Hesperiidae, 34 Papilionidae and 28 Pieridae species. Among these were 81 species endemic to the south of Thailand, and 2 alien species, the Julia (*Dryas iulia*) and the Tawny Coster (*Acraea violae*). Regarding species abundance, 31 species were grouped as very common, 55 as moderately common and 266 as rare. The preferred habitat as expressed by the value of diversity was moist evergreen forest with streams with the highest value of H=4.684, followed by agricultural areas near natural forest with H=4.243, moist evergreen forest without streams with H=3.666, and the last being open areas with H=3.605. Referring to habitat similarity, the highest value was found between moist evergreen forest with streams and agricultural areas near natural forest (C = 61.272), while the lowest value was between open areas and moist evergreen forest without streams (C = 23.457).

This study also confirmed the existence of 3 legally protected butterflies, i.e. the Malayan Birdwing, Common Birdwing and Banded Peacock, all in the family Papilionidae; the first two are also declared insect species in CITES Appendix II.

All the results that were obtained can be further used for developing a management plan for this national park, especially one dealing with the butterfly diversity of the area and to support butterfly watching activity in the near future.

An American butterfly found in Thailand

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The researcher recently found a bright orange butterfly for the first time on Nov. 28, 2008. Later, its name was determined to be *Dryas julia* Fabr. (Heliconiidae), a species in a family which is generally distributed in Continental America. Presently, they are commonly found in Thailand. The caterpillars normally eat Passifloraceae leaves. In particular, they eat *Passiflora foetida* Linn. which is a common weed in Thailand while adult butterflies are attracted to flowers of Siam weed (*Eupatorium odoratum* Linn.). These 2 plants grow wildly in America and Thailand, which is the main factor for their distribution. It is unlikely to have a bad effect on Thailand's environment and economic crops but probably contributes to Thailand's natural beauty. Actually, this alien species has been found in nature since 2007 and has spread mostly in the southern provinces. *Dryas julia* isn't a forbidden species in CITES or on Thailand's list. It was ordered from a Philippine butterfly house to Phuket and nurtured commercially in 1997. Since then, Thai butterfly houses have ordered them from the Phuket farm, e.g., Samui butterfly garden ordered them in 2008. Some of them were released to the surrounding area which is how they spread into our environment and reflect a lack of good policy for preventing alien species being introduced into Thailand's natural environment.

Fortunately, there is no harm to the environment, unlike the Apple Snail's case, which has such a bad effect on Thailand's natural environment. "Prevention is better than cure" is still the best way to prevent environmental damage because once it happens it can not be reversed.

Species diversity of millipedes in rubber plantations and natural forest areas in Nakhon Si Thammarat province

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This study aimed to document the diversity of millipedes in rubber plantations and natural forest areas in Nakhon Si Thammarat Province using Suttherland's method (1999). The study was conducted for one year (June 2008 – May 2009). Rubber plantations in three districts were studied: Thung Song, Na Bon, and Bang Khan. The results showed that Thung Song had ten species in six orders of millipedes. Nine species in six orders of millipedes were found in Bang Khan as well as in Na Bon. Ecological indices of millipedes were compared. The highest species diversity was in Bang Khan, -0.7114, followed by Thung Song, 0.6456, and Na Bon, 0.6015. The highest dominantce was in Na Bon, 0.3167, followed by Thung Song, 0.2752, and Bang Khan, 0.2106. The similarity index indicated that the three districts were the same. Two natural forest areas, at the Center of Natural Agriculture and the area around Yong waterfall, were studied. At the Center of Natural Agriculture, 9 species in 6 orders of millipedes were found, and in the area around Yong waterfall, 8 species in 5 orders of millipedes were found. Again, ecological indices were compared. The species diversity index of Yong waterfall was 1.3890 which is higher than that of the Center of Natural Agriculture, which was 0.7076. However, the dominance index of the Center of Natural Agriculture was 0.2524 which is higher than that of Yong waterfall, which was 0.2478. The similarity index indicated that both areas were similar.

Research on the taxonomy of flatback millipedes in Thailand

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Flatback millipedes have been collected from many areas in Thailand. The family Paradoxosomatidae is dominant and contains 10 genera. The majority of them belong to the three genera, *Desmoxytes*, *Orthomorpha* and *Tylopus*, which, in total contain 42 species. The shocking pink millipede, *Desmoxytes purpurosea*, is a member of this family. Seven described species and 8 unidentified species of *Orthomorpha* and 8 described species of *Tylopus* have been confirmed.

Benthic macroinvertebrate biometrics to assess ecological quality of wetlands in Northeast Thailand

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Benthic macroinvertebrates will be explored in 14 wetlands in NE. Thailand. The study aims to find appropriate biometrics candidates for assess environmental quality of wetlands. In the first year, study will conduct in 3 Lacustrine 6 Palustine and 5 Reservoirs with different levels of disturbance. Mode of microhabitats in each wetlands will be choosed as a representative area in order to reduce variance. Least impaired sites are expected to be reference sites and impaired sites are expected to be test sites. Physicochemical parameters of environmental (such as DO, pH, TDS, Electro Conductivities, BOD, Nutrient etc.) were measured. Habitats were assessed by following standard methods of USEPA (2002). They consist of Buffer Landscape Disturbance, Landscape (immediate) Disturbance, Habitat Alteration - Immediate Landscape Hydrology Alteration and Chemical Pollution. Macroinvertebrates were collected by using a 500 µm D-frame dip net within 500 meters reach. It will be divided into 6 transects and macroinvertebrates samples will be collected according to ratio of microhabitats for 10 sweeps. The macroinvertebrates samples will be sieved through a 250 x 250 µm mesh size sieve then they will be sorted and preserved in 70% ethanol. Identification will be performed to the possible lowest taxonomic levels (genera/species). Multivariate analysis with including clustering and ordination will be applied for detect relationship between physical and biological factors. Landuse and water quality data will be tested with Invertebrates Index (USEPA, 2002). It comprises of taxa richness, composition, tolerance/intolerance, trophic structure and Functional Feeding Groups. They will be tested to screen for candidate metrics for assessing wetland quality. In the second years, the candidate metrics will be test in other wetlands for their precision. We expect to get appropriate benthic macroinvertebrates biometrics to assess ecological quality of wetland.

Species diversity and ecology of ants at Khao Nan National Park, Nakhon Si Thammarat

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Khao Nan National Park (KNNP) is located in Nakhon Si Thammarat Province. Its flora and fauna are diverse. However there is little information about the diversity of ants. The aim of this study was to determine species diversity and ecology of ants at KNNP. Three study sites (Baucheak, Pra Forest, Sunantha trial) were chosen and at each site three permanent plots of 30x30 m at least 500 m apart were selected. Five different methods were used for ant sampling: honey bait (HB), leaf litter sampling (LL), hand collection (HC), pitfall trap (PT), and Winkler Bag (WB). Samples were taken every two months during January 2006-January 2007. Two hundred and forty - five (245) species from 50 genera of ants were detected. These were further classified into 10 subfamilies: Myrmicinae (109 species), Formicinae (55 species), Ponerinae (46 species), Dolichoderinae (15 species), Cerapachyinae (4 species), Pseudomyrmecinae (6 species), Aenicitinae (4 species), Dorylinae (3 species), Ectatomminae (2 species) and Amblyoponinae (1 species). The dorminant genus of ants was *Pheidole* (31 species) followed by *Camponotus* (20 species). Each sampling method produced a different dominant species. Detrended Correspondence Analysis (DCA) showed that there was a distinct difference between the ants present at the Baucheak and Pra Forest sites but there were no distinctive seasonal differences. Canonical Correspondence Analysis (CCA) indicated that soil temperature and air temperature were positively correlated with the distribution and abundance of some ant species.

Assessment of stock and movement patterns for sustainable management of the blue swimming crab, *Portunus pelagicus* (Linnaeus, 1758): A case study in Kung Krabaen bay, Chantaburi province, Thailand

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The blue swimming crab, *Portunus pelagicus* (Linnaeus, 1758), an important economic species for domestic consumption and export, is now in crisis due to a combination of fishing pressure and coastal nursery habitat destruction. Data from the Fishery Department showed that, between 2000 and 2007, total crab production was reduced from 40,000 to 20,000 tonne/year. Kung Krabaen Bay, one of the important blue swimming crab habitats that acts as a nursery ground area, is now facing this crisis. Unfortunately, the local government has no policy to solve this crisis. In terms of scientific study, there has been little research conducted on stock structure and movement patterns of the crab. Therefore, there is a need to explore conflict resolution by using the scientific method to allow better understanding among stakeholders. This study aims at: i) assessing stock of this crab; ii) studying movement patterns and spawning habitat using a marking technique; and iii) analysing current management of the crab fishery in order to propose an appropriate sustainable management strategy for the bay. Field study and laboratory experiments will be designed and conducted based on:

i) biological and ecological study including stock assessment, reproductive biology, natural diet, population structure, abundance and distribution, especially movement patterns. Laboratory experiments will be set up to study tagging effectiveness. Then crabs will be tagged, released and recaptured at the study site. Socio-economic data relating to the crab fishery will be collected.

ii) A workshop will be conducted with stakeholders for exploring the collective action for appropriate sustainable management of the crab in the bay.

Sentinel species for cadmium contamination in the environment: A biomarker study of the rice field crab, *Sayamia* sp., at Mae Sot district, Tak province

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Using an animal as a sentinel species is an approach to monitor the extent of xenobiotic contamination in the environment by examining changes in biological functions of animals living in the area, and use it as a warning sign of potential impacts to other animals including humans. In Thailand, cadmium (Cd) contamination has been reported in agricultural areas of Mae Sot district, Tak province. The rice field crab, *Sayamia* sp., is a common invertebrate that may be affected by Cd-contamination and may transfer the effect to humans who consume it. In this study, the effects of Cd-contamination were examined using changes in body size and activity of glutathione s-transferase (GST) as biomarkers. Crabs were collected during June-November 2008 from 2 sites in Mae Sot including, 1) a contaminated site (Mae Tao subdistrict), and 2) a reference site with no history of Cd-contamination (Mae Pa subdistrict). Analysis for cadmium by GFAAS revealed that cadmium levels in crabs from the contaminated site (0.274 ± 0.100 mg/kg) are significantly higher than those of the reference site (0.010 ± 0.010 mg/kg; *t*-test, $p<0.05$). Comparisons of crab carapace length and weight did not show significant differences between sites (ANCOVA, $p>0.05$). Preliminary results on the specific activity of GST in the hepatopancreas showed that crabs from the contaminated site tended to have higher GST activity than those from the reference site. Our findings indicated that *Sayamia* sp. is responsive to Cd-contamination resulting in an increased body burden of cadmium and elevated levels of detoxification enzymes, making it a suitable candidate as a sentinel species to monitor cadmium contamination in the environment.

Genetic diversity and population structure of the surf clam (*Paphia undulata*) in Thailand

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Surf clams (*Paphia undulata*) have supported an offshore fishery of Thailand since the 1970's. The industry steadily grew for two decades due to increased demands. However, since 2000, the fishery resource supply is being depleted. Overexploitation and low genetic variability of surf clam populations could be the major factors contributing to declines in the commercial catch in recent years. In this study, nine inter-simple sequence repeat (ISSR) markers were used to assess genetic diversity from five populations in the Gulf of Thailand and one stock from the Andaman Sea coast. Surf clams were collected from fishing areas of Samut Songkram, Samut Sakorn, Samut Prakan, and Surat Thani Provinces on the Gulf of Thailand and from Satun Province on the Andaman Sea. The Samut Songkram and Samut Sakorn stocks exhibited relatively high genetic variation and were similar with 75.76% and 73.74% of polymorphic loci and genetic diversity of 0.1072 and 0.0981, respectively. The genetic variation, however, was moderate for Samut Prakarn and lower for Surat Thani and Satun with 45.71%, 23.99%, and 20.45% of polymorphic loci and genetic diversity of 0.0913, 0.0372, and 0.0342, respectively. The five different geographic populations were divided into two subgroups based on a UPGMA dendrogram using Nei's genetic distance. The relatively high levels of genetic variation of the Samut Songkram and Samut Sakorn populations were partly due to protection programs managed by local fishermen.

Population parameters and diet of an invasive alien sailfin molly, *Poecilia velifera* (Regan, 1914) in Songkhla Lake Basin

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Established populations of the sailfin molly, *Poecilia velifera* (Regan, 1914), have been recorded for the first time in Songkhla Lake Basin, south Thailand. From a prelimanary survey, we know they are currently established along the entire coastline of Thale Sap Songkhla sub-basin and Haad-kaew Lagoon (adjacent to the mouth of Thale Sap Songkhla). Biological data show that their male : female ratio is 1:2. First maturation occurs at 16.8 and 17.1 mm SL in males and females, respectively, whereas their maximum standard length is 69.8 mm. They reproduce continuously with 3-252 offspring each. They feed mainly on plant matter and unicellular algae; however, they also feed on aquatic organisms' eggs, nematodes, insects, crustaceans and fish larvae, in small amounts. Their preferred habitat is vegetated coastal areas and they are predicted to spread rapidly throughout the region and probably have an adverse impact on many indigenous species as the result of predation and competition for food and space. On the other hand, populations of *P. velifera* may provide a food source for predatory fishes in their environment.

Occurrence of an invasive false mussel *Mytilopsis adamsi* Morrison, 1946 in estuaries and lagoons of the lower Gulf of Thailand and variability in its recruitment

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Over the past decades the invasive false mussel, *Mytilopsis adamsi* Morrison, 1946 (Bivalvia: Dreissenidae), a brackish water bivalve native to the tropical West Pacific coast of central America has spread across the Indo-Pacific region, and is now established in estuaries and lagoons of the lower Gulf of Thailand. *M. adamsi* populations were observed in Songkhla Lake Basin, in Songkhla province, and the Pak Phanang Estuary in Nakhon Si Thammarat province, south Thailand. The species was suggested to have been transported to the area between the years 1990 and 2000 via international commercial cargo ships. In the infected area, this mussel rapidly forms dense monocultures and attaches to all types of submerged hard surfaces. A study of variability in *M. adamsi* recruitment was conducted and it was found that there were two peaks of recruitment during a year; a minor peak occurred in July 2007, and a major peak in January 2008. The density of *M. adamsi* recruits was negatively related to salinity, but was positively related to the densities of cyanophytes, phytoflagellates, and diatoms. This suggested that *M. adamsi* reproduction probably preferred low salinity, and that these groups of phytoplankton might be the main foods of this mussel.

Integrated and collaborative ecological and socio-economic modelling for sustainable razor clam management at Don Hoi Lord ramsar site, Thailand (ecological aspects)

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Razor clams are economically important for communities surrounding Don Hoi Lord. Recently, razor clams at this site have declined rapidly compared with past records. This study aims to explore possible sustainable management policies for Don Hoi Lord Ramsar Site by integrated and collaborative ecological and socio-economic modelling. A companion modelling approach was selected for the study. Investigations of current razor clam population dynamics and some ecological factors especially organic carbon in water are needed for incorporation into Agent Based Simulation Modelling (ABSM). A monthly field study has been conducted since June 2008. Four line transects and 14 stations were used to investigate the population. In addition, pH, Salinity, DO, and water temperature were measured. Particulate Organic Carbon (POC) was collected from water at each station in order to quantify organic carbon. During one year of data collection, the results showed that razor clam densities were 0.07-0.92 clam/m^2. The maximum population density occurred in May 2009 and the minimum in October 2008. The mean size of razor clams was 5.15±1.51 cm and the major size in population structure was > 5 cm. Compared with previous data, the population has sharply decreased while the mean size seems to have increased. Regarding ecological factors, it was shown that measured factors concurred with water quality standards, except in October 2008 when pH and DO were lower than the standard. Furthermore, POC in water ranged from 309.55 – 2676.25 µm/liter.

Potential use of glutathione s-transferase activity in the freshwater snail, *Pila* sp., as a biomarker for cadmium contamination in the environment at Mae Sot district, Tak province

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Contamination by cadmium can cause adverse effects in animals including the initiation of oxidative stress. Consequently, animals use several mechanisms to detoxify byproducts of oxidative stress including producing enzymes such as glutathione s-transferase (GST). In Thailand, cadmium contamination has been found in agricultural areas at Mae Sot district, Tak province. We aim to examine the effects of cadmium in the environment on GST activity of the native freshwater snail, *Pila* sp. Since the snail lives in and is exposed to the contaminated environment and is also used as local food, it is thus suitable to be used as a sentinel species. Snails were collected during June-November 2008 from 2 sites at Mae Sot including a contaminated site in Mae Tao subdistrict and a reference site with no history of cadmium contamination in Mae Pa subdistrict. Analysis for cadmium by GFAAS showed that snails from the contaminated site have significantly higher levels of cadmium (1.368±0.070 mg/kg) than those of the reference site (0.075±0.046 mg/kg; *t*-test, $p<0.05$). There was no significant difference in body weight when compared between sites using shell length as a covariate (ANCOVA, $p>0.05$). An assay for specific activity of GST showed a trend of increased GST activity in the hepatopancreas of snails collected from the contaminated site compared to the reference site, with significant site-related differences between the males (*t*-test, $p<0.05$). The findings indicate associations between cadmium contamination and change in GST activity of the freshwater snail which could be further used to develop a biomarker for monitoring the level of cadmium in the environment in the future.

Diversity study on echinoderms in Had Khanom – Mu Ko Thale Tai National Park, Nakhon Si Thammarat Province

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Echinoderms of Had Khanom – Mu Ko Thale Tai National Park, Nakhon Si Thammarat Province, located in the southern part of the Gulf of Thailand were studied at 12 sites at Ko Tan (4 sties), Ko Mudsum (2 sites), Ko Wang Nai (2 sites), Ko Wang Nok (2 sites) and Ko Rab (2 sites) in November, 2006 and May 2008. The investigations were carried out by SCUBA diving in the daytime and random searching throughout the reefs. The results yielded 24 species of Echinoderms from 5 classes, 10 orders, 14 families and 20 genera. The most abundant echinoderms in the study area are: *Lamprometra palmata, Ophiothrix (Ophiothrix) exigua, Holothuria (Metensiothuria) leucospilota* and *Diadema setosum*. All observed species are commonly found in the Gulf of Thailand and the Indo-Pacific.

The ecology of dynamics in rivers in Thailand: Co-existence strategies

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High species richness is contrary to the concept of competitive exclusion. However, recent theoretical evidence suggests competitive exclusion need not occur where life history strategies or tactics differ such that an advantage at one life cycle stage implies a disadvantage at another. Where life histories do not imply advantages, increasing competition should decrease species evenness and, eventually, species number. High diversity is expected where competition is weak. This suggests that in Southeast Asia, species have acquired strategies or tactics such as may be related to habitat, feeding and reproduction that allow them to share rather than compete for resources.

This project has four objectives:

1. Feeding dynamics of fish communities: competition or sharing? Benthic fishes display distinctive temporal feeding patterns and small but significant differences in diet that are currently being re-examined by stable isotope analyses.
2. Reproduction tactics and fecundity in fishes. Balitorid species are being collected monthly from several rivers with measurements of fish size, gondal somatic ratio, fecundity and maximum egg diameter. Spawning times and habitat are being documented.
3. Species number in relation to watershed size and location: sampling of fish by electrofishing and quantitative statistical protocols are being applied to information collected from rivers throughout Thailand.
4. Why fish are where you find them: an integrative synthesis of morphological, physiological and hydrodynamic characteristics within fish communities.

Environmental sensitivities of riverine fishes and the development of a bioassessment model with which to evaluate water quality

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The total abundance of fish and the number of species captured by electrofishing at 95 sites in small rivers varied significantly with physicochemical factors. Species numbers were negatively and positively related with pH and dissolved oxygen, respectively. Abundance varied inversely with discharge and ambient ammonia and, directly with depth, substratum, ambient oxygen and alkalinity. Fish were represented by 62 species, the most common being *Rasbora paviei*, *Systomus binotatus* and *Channa gachua.* Canonical Correspondence Analysis related species and their abundances with eight environmental variables into four groups. The most species-rich group was associated with approximately average values for the significant variables. The group with the fewest species was associated with high oxygen and low ammonia and alkalinity. The other two groups had similar numbers of species, one being associated with high ammonia and alkalinity and low oxygen. Species in the other group were found at locations where rivers were relatively wide with comparatively high oxygen and low ammonia concentrations. This appears to be the first analytical examination of fish habitat in small rivers of Thailand and provided the information for the development of a bioassessment model with which to evaluate general water quality or integrity. Eight factors or metrics were selected for this evaluation: species richness; abundances of Cyprinidae, Balitoridae and indicator species; species numbers of insectivores (invertivores) and carnivores; total fish abundance and numbers of non indigenous species. These metrics should also be beneficial to conservation, especially in providing restoration guidelines for impaired habitats.

Abundances and distributions of the alien fish species, *Hypostomus* spp., in water bodies in Chonburi province and their biological impact on the broadhead catfish (*Clarias macrocephalus)*

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Invasive alien species are known to cause problems worldwide since they distribute themselves very quickly and compete for food and habitat with endemic species. Such problems can lead to the decrease of indigenous species and can put them in a critical situation. In Thailand, the Suckermouth catfish or *pla dudd* (local Thai name) is an alien species and now spreading across the country. They were introduced from South America about 50 years ago to clean algae attached to submerged surfaces and to eliminate food left in fish aquaria. However, when they are fully grown, they are intentionally released into public waters. The negative impact of the Suckermouth catfish on the ecosystem and on other fish species comes mainly from their feeding behaviour. Suckermouth catfish plow along the substrate and suck up fine sediments and scrape food from hard surfaces. This behaviour is likely to damage or destroy eggs of indigenous fish such as the Broadhead Catfish (*Clarias macrocephalus*) that lays their eggs on sediments. Furthermore, re-suspension of sediments caused by plowing of Suckermouth catfish may cover food sources of other fish species and may cause other fish populations to decline. Little is known about the numbers and species of Suckermouth catfish in Thai waters, and scientific research regarding threats to Thai native species has never been pursued. Therefore, it will be very interesting and challenging to conduct in depth research on the negative impacts of the invasive, alien Suckermouth catfish on native fish in Thailand.

Comparisons of fish communities among seagrass beds, mangroves, sandy beaches and mudflats at Had Khanom Mu Ko Thale Tai National Park, Nakhon Si Thammarat Province

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Had Khanom Mu Ko Thale Tai National Park encompasses various important coastal ecosystems such as mangroves, seagrass beds, coral reefs and other types of wetlands which act as spawning, nursery and feeding grounds for various kinds of aquatic life. Nowadays, the increasing loss of heterogeneous coastal habitats as well as the consequences of a number of human activities, such as sedimentation from construction into the sea, encroachment and reclamation of mangrove forests, wastewater from fisheries industries and domestic sources, illegal and destructive fishing, over fishing, all cause reductions in the ecological roles in goods and services of the Had Khanom coastal ecosystems.

This study explores the fish assemblages of various habitats including seagrass beds, mangroves, sandy beaches and mudflats within Had Khanom Mu Ko Thale Tai National Park in order to describe the relative importance of each habitat type in terms of diversity, abundance, and biomass of fish species of commercial importance throughout the year, as well as to determine the size distributions of fish in these habitats the data for which will be collected using a beach seine. This study will provide basic ecological information and understanding for decision makers, coastal zone managers, and park rangers for coastal zone management and conservation that eventually will lead toward sustainable development.

Genetic diversity of the rice field frog, *Hoplobatrachus rugulosus* (Wiengmann, 1835), in natural habitats in Thailand by mitochondrial DNA (12S rRNA and cytochrome-b sequences)

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The rice Field Frog (*Hoplobatrachus rugulosus*) belongs to the family Ranidae, genus *Hoplobatrachus*. It can be found from East Asia to throughout the Thai-Malay peninsula. Recently, the population of this frog in its natural habitat has been found to be decreasing because of habitat destruction, pollution, pesticide usage, hunting and climate change. To study the genetic diversity, we sampled rice field frogs from 4 regions in Thailand: 1) the Northeastern montane region (Nan and Tak provinces), 2) the Thai-Lao dry plateau (Sakhon Nakhon, Udon Thani, Mukdahan, Nakhon Ratchasima and Ubon Ratchathani provinces), 3) the Southeast Asian lowlands (Chonburi, Sa-Kaew, Chanthaburi, Trad, Nakhon Nayok and Phetchaburi provinces) and 4) Tenasserim and the Malay peninsula (Chumphon, Phang-nga and Songkhla provinces). DNA was extracted from each sample. Segments of mitochondrial 12S rRNA and cytochrome-b genes were amplified and the nucleotide sequences of these genes were analyzed. Comparisons of the 12S rRNA and cytochrome-b sequences indicates that the rice field frog population in Thailand can be grouped into two major clades: 1) those from the Southeast Asian lowlands, Tenasserim-Malay peninsula and the Northeastern montane region (Tak province), and 2) those from the Thai-Lao dry plateau, Southeast Asian lowlands (Trad, Sa-Kaew and Chathaburi Provinces), Tenasserim-Malay peninsula (Chumphon province) and Northeastern montane region (Nan province).

Vertical distribution and diets of the Median-striped bullfrog, *Kaloula mediolineata* (Smith, 1917), in Sam Ngao district, Tak province

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The vertical distribution and diet composition of the Median-striped bullfrog, *Kaloula mediolineata* (Smith, 1917), were studied in Sam Ngao district, Tak province, Thailand, from July 2006 to June 2007. The results show that the average depth of frog burrows in the dry months (December 2006 to March 2007, average = 56.60 mm, N = 75) was significantly deeper than wet months (July to November, 2005 April to June, 2006, average = 31.59 mm, N = 140). Significantly negative correlations were observed when comparing the vertical distribution to the following physical factors: soil surface moisture (R = -0.298; p = 0.000), relative humidity (R = -0.249; p = 0.000) and air temperature (R = -0.213; p = 0.002).

Moreover, diet composition was analyzed. The results show that only empty stomachs were observed during the dry months, whereas during the wet months, empty stomachs were observed in 42.9% of specimens. The main food items were ants (Order Hymenoptera, Family Formicidae), termites (Order Isoptera) and beetles (Order Coleoptera). The stomach contents were similar in both female and male frogs (Simple Similarity Index between 0.91-0.99). Furthermore, a relationship between diet and prey availability was observed (tau = 0.469, p = 0.046). In conclusion, the results suggest that the Median-striped Bullfrog is a generalist predator which is active in the wet months, and that ants, termites and beetles are the main food-sources of the frog.

The ornate chorus frog, *Microhyla fissipes*, as a sentinel species for cadmium contamination in the environment at Mae Sot district, Tak province

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Cadmium contamination of the environment has been found in agricultural areas of Mae Sot district, Tak province, since 2003. However, there is very little information on its effect on animals in the area. In this study, the ornate chorus frog, *Microhyla* fissipes, was selected as a sentinel species for monitoring the effect of cadmium contamination on vertebrate populations. Frogs were collected during June-November 2008 from 2 areas in Mae Sot including 1) a contaminated site at Mae Tao subdistrict, and 2) a reference site with no history of contamination at Mae Pa subdistrict. Analysis for cadmium in frog samples by GFAAS indicated that cadmium levels in frogs from the contaminated site (0.47 ± 0.07 mg/kg) are markedly higher than in the reference site animals (non-detectable). Gravimetric comparison showed that female frogs from the contaminated site have significantly higher kidney weight, and significantly lower ovarian weight than those of the reference site, while male frogs from the contaminated site have significantly greater liver and kidney weights, and significantly lower testicular weight compared to the reference site animals (ANCOVA, $p<0.05$). Age determination by skeletochronology showed that average age is not significantly different between sites (Mann-Whitney U-test, $p>0.05$) but longevity of males from the contaminated site (3 years) is relatively shorter than those of the reference site (4 years). Overall results indicate that cadmium contamination in the environment can negatively affect the frogs, resulting in cadmium accumulation and changes in weights of livers, kidneys and gonads, as well as having a potential impact on the age structure of the population.

Effects of atrazine on the early development and gonad development of the rice field frog, *Hoplobatrachus rugulosus* (wiegmann, 1834)

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Agrochemical and chemical contamination of the environment are considered to be disastrous causes of amphibian declines. Atrazine is generally applied in the rainy season when amphibians are congregating; therefore, frogs either in agricultural fields or adjacent wetlands could be exposed to atrazine. This study was designed to determine the effects of atrazine on the embryonic and larval development of the rice field frog, *Hoplobatrachus rugulosus* (Wiegmann, 1834), a common frog species in Thailand. The first part was to determine the normal embryonic and larval developmental of *H. rugulosus* to find out the time period of each developmental stage for the following experiments. The second part was to determine the effects of atrazine on early development of *H. rugulosus*. The early embryos at the mid-blastula stage were treated with ecologically relevant nominal concentrations, *i.e.*, 0.001, 0.01, 0.1, 10, 100, and 1,000 ppb, using the FETAX protocol. The results showed that the nominal concentrations of atrazine used in this experiment did not cause significant statistical effects ($p<0.05$) on mortality rate, snout-vent length and developmental abnormalities, even though certain abnormalities, *i.e.*, tail flexure and abdominal edema, were found in all treatment groups (except 0.01 ppb). The last part was to determine the effects of atrazine on gonad development and later developmental stages. The early embryos were treated with nominal concentrations of atrazine, *i.e.*, 0.001, 0.01, 0.1, 10, 25, 100, and 1,000 ppb, respectively. The embryos were treated with atrazine until the animal completed metamorphosis. The results showed that nominal concentrations of atrazine did not cause any effects on metamorphosis and gonad development of *H. rugulosus* ($p<0.05$). In conclusion, it is suggested that pure atrazine at ecologically relevant concentrations was not capable of causing direct effects on *H. rugulosus* development under laboratory conditions.

Molecular cloning of antimicrobial peptide genes from the tree frog, *Rhacophorus feae*

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Antimicrobial peptides (AMPs) play an important role in the innate immunity of virtually all organisms. The major mode of action of most AMPs is disruption of the membranes of microorganisms. Because this mode of action is rather non-specific, most AMPs therefore exhibit broad-spectrum activity against bacteria, parasites, viruses and even cancer cells. Here we report the molecular cloning of AMP genes from the tree frog, *Rhacophorus feae,* and the screening for suitable drug lead candidates. The genes were cloned by the RT-PCR technique using poly-A RNA isolated from skin secretions. The DNA sequences of the cloned genes were then used to predict the mature peptide sequences which were screened further by bioinformatic analysis. The screened peptides were then synthesized using solid-phase peptide synthesis and the peptides were subjected to antimicrobial peptide assay, MTT assay and hemolytic assay. We found that one of the peptides, RF28, showed strong activity against gram negative bacteria and certain types of cancer cells but had low toxicity towards red blood cells and fibroblast cells. Interestingly, this is the first report that many AMPs that we found in this tree frog have characteristics of AMPs found in *Ranid* frogs, thus suggesting that these AMPs have evolved before the spitting of frogs into the two families, Ranidae and Rhacophoridae.

Seasonal activity of amphibians in Nam San Noi stream, Phuluang wildlife Sanctuary

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Seasonal activity of amphibians in Nam San Noi stream, Phuluang Wildlife Sanctuary, was studied from May 2006 to May 2007. Night visual encounter surveys were conducted on three 100 m stream transects at each of three elevations, 800, 950, and 1250 m. Each stream transect was surveyed once a month. Species and numbers of amphibians found in each survey were recorded. A total of 22 species was found during the survey period. The species diversity in the wet season was higher than in the dry season at all three elevations. The similarity index indicated that species composition between seasons at 1250 m were similar, whereas at 800 and 950 m they differed. The total abundance of all species and abundances of the 6 most common species had significant differences between the wet and dry seasons. The abundances of *Odorrana aureola* and *Odorrana chloronota* were high during the wet season while the numbers of *Limnonectes gyldenstolpei*, *Hylarana nigrovittata*, *Aquixalus bisacculus*, and *Microhyla berdmorei* and total abundance of all species peaked in the dry season. The highest abundances of the most common species were found to be associated with breeding activity. Canonical Correspondence Analysis (CCA) indicated that the year-round abundances of most amphibians at different elevations were associated with stream size, water temperature, and substrate temperature whereas the variations in amphibian abundance between seasons at each elevation were associated with relative humidity, water temperature, air temperature, substrate temperature, and stream width.

A recent survey of the big–headed turtle, *Platysternon megacephalum*, Gray 1831 in Thailand

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Platysternon megacephalum Gray, 1831was recently surveyed in Thailand from December 2006 to April 2009. The study confirms the occurrence of *P. megacephalum* in ten river basins in northern, northeastern, central and western Thailand. Among these, many new localities with elevations between 430–1,350 m asl were reported. *P. megacephalum* was mostly found in small flowing mountain streams in dry dipterocarp forest and montane rain forest. Its populations face serious threats from habitat loss, human consumption and commercial harvest of turtles. This species urgently needs a proper conservation action.

Habitat selection and relationships between annual occurrence of amphibians and climatic factors at Khao Sip Ha Chan National Reserve Forest, Chantaburi province

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The occurrence of both tadpoles and adults of amphibians in habitats was obtained by visual encounter surveys from January – December, 2008. Data collection comprised species, numbers and habitat utilization. Climatic factors such as temperature, relative humidity, and rainfall were collected from the nearest climatalogical station. Data were analyzed using a statistical program. This study of habitat selection showed 13 microhabitats, both lowland and streamline, used by amphibians, especially in hydroperiod relationships. The number of individuals was positively correlated with rainfall, but the number of species was not correlated with climatic factors. The number of tadpole species in the lowland was positively correlated with rainfall but the number of tadpole species in the streamline was positively correlated with temperature and wet season and had a higher diversity index than in the dry season.

The evolution of Mesozoic biodiversity in Thailand: Phase II

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The study of the evolution of Mesozoic biodiversity in Thailand in the phase II project, 2nd phase of the 3rd year, is continuing and several new genera and species of prehistoric animal have been found, including 1 dinosaur, 2 crocodiles and 1 turtle. Research reports have been published in international journals in over 10 issues. *Kinnareemimus khonkaenensis* gen. nov. and sp. nov., a small, bipedal, toothless-beaked, agile Ostrich-like dinosaur about 1-2 meters long was found in the Sao-Koa formation (Early Cretaceous period about 130 m.y.o). Two new species of crocodiles were found in Sao-Koa formation (Early Cretaceous period about 130 m.y.o). One is *Siamosuchus phuphokensis* gen. nov. and sp. nov. Another is *Khoratosuchus jintasakuli* gen. nov. and sp. nov. that was found in the Kok-Kruad formation (Early cretaceous period about 100 m.y.o). In the PhuKadung formation at Ban Khumpok, Mukdahan, a new species of big turtle (about 1 meter long) was found and given the name *Basilochelys macrobios* gen. nov. and sp. nov. which means "long lives the king turtle" in honor of his Majesty the King of Thailand.

For excavation, several potential dinosaur fossil sources were found such as prosauropods and sauropods in the Namphong formation at Phukadung district, Lei, and a dinosaur site in the Phu Kradung Formation at Phunoi Kummuang district, Kalasin and Ban Khumpok, Mukdahan.

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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Staging and wintering sites of shorebirds are important for successful migration and the survival of the birds and, therefore, knowledge about feeding ecology at these sites is crucial. However, little is known of the feeding ecology of shorebirds in Asia. This study was conducted in sewage treatment ponds and salt ponds at one site on the western shore of the Inner Gulf to examine the effects of seasonal food availability on foraging patterns and body weight of adult and juvenile Long-toed stints, *Calidris subminuta*, during a 21 month period. Seasonal differences in food availability, peck rates, pace rates, chasing rates, and weights were compared among three periods of the typical shorebird overwintering period, i.e., Apr, Jul–Sep, and Nov–Feb. The most abundant invertebrates in the treatment ponds were Chironomidae (blood worm/midge) and Ephydridae (shore flies) in salt pans. Jul–Sep had higher invertebrate density than in Apr or Nov–Feb. Body weights of juveniles and adult Long-toed Stints did not differ significantly among the three periods. However juveniles and adults had higher weights during Apr and Jul–Sep than during Nov–Feb. Long-toed stint peck rates in the treatment ponds and salt ponds were not significantly different. Long-toed stint step rates in salt pans were however significantly higher in the treatment ponds, probably reflecting lower food densities in the salt ponds. Overall, there was a strong correlation between invertebrate density and number of shorebirds in the treatment ponds suggesting that the shorebird community closely tracks food supply. Further work on invertebrate dynamics and shorebird diets in the Inner Gulf are needed to clarify this relationship.

Isolation and characterization of highly polymorphic microsatellite loci in the Asian elephant

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Baby elephants are known to be stars in the Thai tourism business since they are lovely, smart, and skillful in performing shows. A baby elephant may be worth 800,000 baht or more, leading wildlife authorities to require proof that young elephants were born in captivity rather than illegally captured from the wild. Genetic testing using polymorphic microsatellite DNA markers can provide the data needed for verification of maternity, in which the baby would be accepted as captive born if a captive female can be assigned to be its mother. We have constructed an Asian elephant microsatellite enriched DNA library and developed over forty microsatellite loci. Fourteen of them were chosen for evaluation of polymorphism in 20-35 captive elephants. We found six loci that were highly polymorphic and pooled them together with other loci that were chosen from Kongrit *et al*. (2008) and Comstock *et al*. (2000) to form a kit consisting of seventeen highly polymorphic microsatellites. We used the program CERVUS 3.0.3 for preliminary testing of the kit's efficiency using 35 captive elephants and found that it correctly assigned the right mother for all eighteen baby elephants with 95% confidence. We also used the genotypes of these 35 elephants to construct an allele sharing matrix and found that the correct mother-offspring pairs had allele-sharing of between 0.50-0.68, while the non-mother-offspring pairs had average allele-sharing of 0.36; only 32 out of 612 non mother-offspring pairs had allele-sharing greater than 0.50.

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